Railway Age

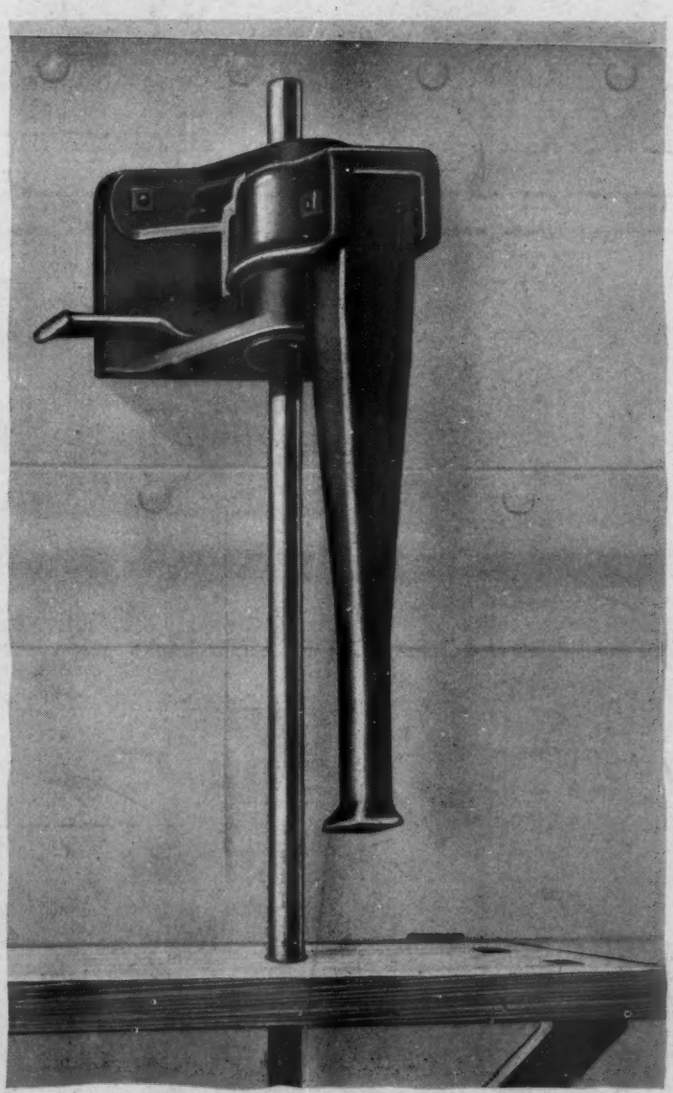
DAILY EDITION

FIRST HALF OF 1919—No. 25e NEW YORK—WEDNESDAY, JUNE 25, 1919—ATLANTIC CITY SIXTY-FOURTH YEAR

Published weekly by Simmons-Boardman Pub. Co., Woolworth Bldg., New York, N. Y. Subscription Price, U. S. and Mexico, $5.00 a year; Canada, $6.00; foreign countries (excepting daily editions), $8.00. Entered as second-class matter, January 30, 1918, at the post office at New York, N. Y., under the act of March 3, 1879.

MINER

IDEAL SAFETY HAND BRAKE



POWERFUL

PERFECT

DURABLE

SELF-CONTAINED

EXTENSIVELY IN USE

PIER SPACE 584-585

W. H. MINER CHICAGO

Alphabetical Index to Advertisements, Page 78

McCORD AND COMPANY

Journal Box Specialists for Twenty-Two Years

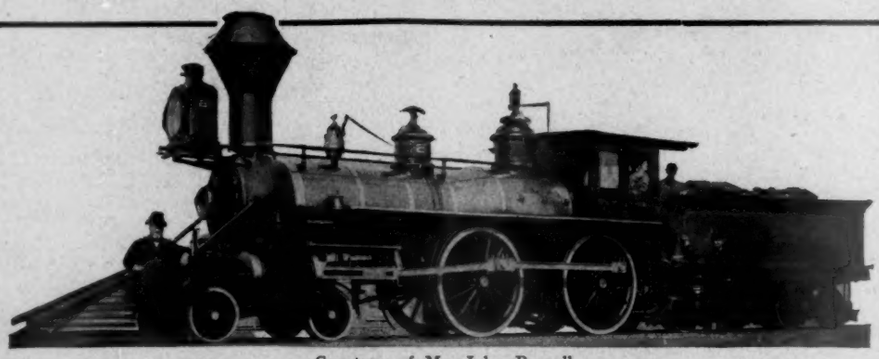
Manufacture Journal Boxes in—

Composite Cast and Pressed Steel **Malleable Iron**
Cast Steel **Cast Iron**

Equipped with the well known McCord Lid, which keeps the dust out, and keeps the oil in

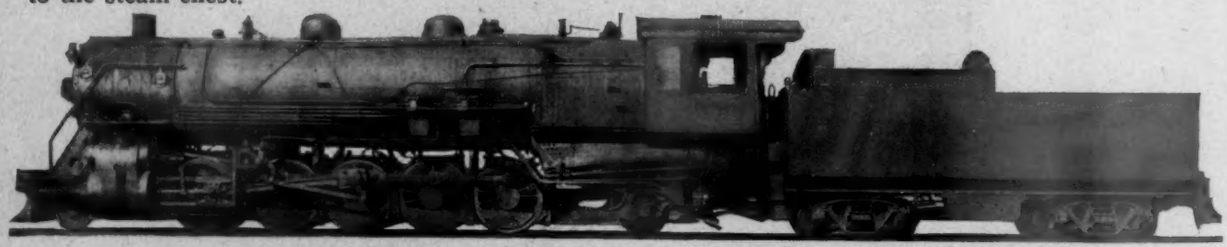
THE HOLDEN COMPANY, Ltd.

CHICAGO MONTREAL NEW YORK



Courtesy of Mr. John Purcell

It is a long step in design from this early locomotive to this modern one.
It is an equally long step from the lubricator design (the tallow cup) shown on the early locomotive to the SCHLACKS SYSTEM OF LOCOMOTIVE FORCE FEED LUBRICATION, shown on the modern locomotive.
It is interesting to note that the lubricator was moved from the steam chest to the cab and back again to the steam chest.



LOCOMOTIVE LUBRICATOR COMPANY

Booth No. 574, Atlantic City, N. J. 1202 Tower Bldg., Chicago, Illinois

Railway Age

DAILY EDITION

Copyright, 1919, by the Simmons-Boardman Publishing Co.

VOLUME 66 JUNE 25, 1919 NUMBER 25c

PUBLISHED EVERY FRIDAY AND DAILY EIGHT TIMES IN JUNE BY THE
SIMMONS-BOARDMAN PUBLISHING COMPANY,
WOOLWORTH BUILDING, NEW YORK.
EDWARD A. SIMMONS, *President.*
L. B. SHERMAN, *Vice-Pres.* HENRY LEE, *Vice-Pres. & Treas.*
ROY V. WRIGHT, *Secretary.*
CHICAGO: TRANSPORTATION BLDG. CLEVELAND: CITIZENS' BLDG.
WASHINGTON: HOME LIFE BLDG. CINCINNATI: FIRST NATIONAL BANK BLDG.
LONDON, ENGLAND: 85, FLEET STREET, E. C. 4.
CABLE ADDRESS: URASIGMEC, LONDON.

EDITORIAL STAFF:
SAMUEL O. DUNN, *Editor.*
ROY V. WRIGHT, *Managing Editor.*

W. E. HOOPER	C. B. PECK	C. W. FOSS	A. G. OEHLER
E. T. HOWSON	W. S. LACHER	K. E. KELLENBERGER	HOLCOMBE PARKES
B. B. ADAMS	J. G. LITTLE	F. W. KRAEGER	E. A. BIERY
H. F. LANE	A. F. STUEBING	B. W. MEISEL	C. N. WINTER
R. E. THAYER			

BUSINESS DEPARTMENT REPRESENTATIVES

C. R. MILLS	R. H. SMITH
F. S. DINSMORE	F. J. FISCHER
F. H. THOMPSON	J. M. RUTHERFORD
H. H. MARSH	H. L. BURRHUS
F. C. KOCH	J. P. RISQUE

Entered at the Post Office at New York, N. Y., as mail matter of the second class.

Subscriptions, including 52 regular weekly issues and special daily editions published from time to time in New York, or in places other than New York, payable in advance and postage free; United States and Mexico, $5.00; Canada, $6.00; Foreign Countries (excepting daily editions), $8.00 (£-15s;-0d.); single copies, 15 cents each. Subscription Agents for Great Britain and Egypt: The Dorland Agency, Ltd., 16 Regent Street, London, S. W. 1.

WE GUARANTEE that of this issue, 16,825 copies were printed; that of these 16,825 copies, 15,406 were mailed to regular paid subscribers to the Railway Age and the Railway Mechanical Engineer; 119 were mailed to advertisers, 300 were provided for counter and news companies' sales, new subscriptions, bound volumes, copies lost in the mail and office use, and 1,000 copies for distribution at Atlantic City.

THE RAILWAY AGE is a member of the Audit Bureau of Circulations (A. B. C.) and the Associated Business Papers. (A. B. P.)

The convention which will close to-day will be unanimously voted the most successful mechanical convention ever held. It may have a great influence upon the efficiency of American railroads in future. Railroad expenses at present are extremely high chiefly owing to increases in the wages of labor and the prices of fuel and materials. If greater economy of operation is to be secured, it must be done chiefly by using less labor, fuel and materials to move a given amount of traffic. Greater efficiency in the use of labor, fuel and materials can be obtained only by the employment of better operating methods and better machinery and equipment. The better methods of operation must be worked out principally by railway officers.

The Most Successful Convention

The better machinery and equipment must be provided by the railways and the railway supply companies jointly. Never was so much equipment and machinery adapted to saving labor and materials on railways shown at one time and in one place as has been shown on the Pier at Atlantic City within the last two weeks; and never was such equipment and machinery examined by so many railway operating and mechanical officers in so short a time. Equipment and machinery to save labor cannot be provided by the railways in sufficient quantities to accomplish the maximum practicable results unless they have available the money which must be spent in order to buy it; and they cannot get enough money unless their rates are made reasonable and their earnings adequate. There are strong indications, however, that after the carriers are returned to private operation they will be regulated in a more liberal and intelligent manner than they have been in the past; and if they are, railway officers, realizing better than they ever did before, both the imperative need for better methods and machinery, and the fact that better machinery is available if they can only buy it, will introduce an era of increasing efficiency in operation that will surpass any known in the past. The interest, the optimism and the enthusiasm shown by both railway men and railway supply men or this convention is a good omen as to the future of both the railway and the railway supply industries.

The Electric Headlight Situation

THE REPORT OF THE COMMITTEE on electric headlights of the Association of Railway Electrical Engineers which was presented before the semiannual convention of the association on Monday, and which was again read before the meeting of the Mechanical Section of the American Railroad Association on Tuesday deals with a subject which is a particularly live one at the present time because of the large number of locomotives that are being equipped with headlights. The first presentation of the report provoked a great deal of discussion and brought out many and diverse opinions as to just what should be considered as standard practices in the various parts of the equipment. While the work of the committee indicates that it obtained information from a large number of roads as to the practices that are being used, it is plainly evident that the time is not yet ripe to bring about a complete standardization of locomotive elective headlights, is not probable or advisable. There will eventually be standard practices adopted in some of the roads will all agree on the same methods of installing the wiring, conduit, switches, turbo-generators, etc. Unquestionably the several roads will retain their own practices to a large extent. Although methods of installation cannot be generally agreed upon there are certain parts of the electric headlight which can be made standard, such as the capacity of the generators, voltage of the lamps, kind of wire to be used, as well as lamp fixtures. These parts can readily be made standard on all roads and have already been made so to a large extent. The actual necessity for standardization of methods of installation is not a paramount issue, however, since locomotives are seldom used on any other than their own lines and the equipment adopted by any one line will not conflict in any way with the practices of the other lines.

The report as submitted by the committee should not be considered as a final attempt at standardization, but rather as an outline which represents the main features of present practice on a number of the largest roads and something which may be changed from time to time as necessity seems to dictate.

Economics of Stoker-Fired Locomotives

THE REPORT OF THE COMMITTEE on Locomotive Stokers showed that while great progress has been made in applying stokers to locomotives, little or no work has been done during the past two years with a view to determining the results secured or the net effect of stokers on the cost of conducting transportation. The report contained several suggestions regarding matters in connection with mechanical stokers which required further study. The cost of stoker maintenance as reported by the roads using them, showed wide variations. In view of the difficulty experienced in operating stokers with certain kinds of coal it might be well to keep a separate record of the cost of maintaining the crusher in order to

determine whether the cost of maintenance could be reduced by eliminating this feature and preparing the coal at the chutes. The method of operating stokers to secure the maximum fuel economy was mentioned in the course of the discussion, and while it is not certain that it has any marked influence some consideration should be given to the matter.

The committee stated that the size of a locomotive is not the controlling factor in determining the advisability of applying a stoker. Any data that could be furnished to enable the roads to judge the advisability of equipping a given type of locomotive with a stoker would prove extremely valuable and it is to be hoped that the committee will carry on investigations with this object in view.

The economics of the operation of stoker-fired locomotives are so important that tests should be arranged to determine the most economical methods under various conditions. Stoker-fired locomotives can be worked at higher rates of combustion than hand-fired engines and as a rule the increased evaporation secured is utilized to haul heavier tonnage, although it might be used to increase the speed of the train. As the rate of combustion increases the efficiency decreases, but the heavier tonnage hauled reduces the cost of wages on the ton-mile basis an amount which is generally assumed to more than compensate for the increase in the cost of fuel. The maximum economy of operation cannot be secured unless it is definitely known whether the combined cost of fuel and wages per ton-mile decreases constantly with the increase in tonnage up to the point where the locomotive is loaded to the limit of the available tractive effort. It is to be hoped that the next report of the committee will include cost data bearing on this question.

Pyrometers for Superheater Locomotives

IN DISCUSSING THE REPORT of the Committee on Superheater Locomotives one of the speakers urged the use of pyrometers to check the temperature of the steam and characterized the device as quite as necessary as the steam gage. There is no doubt that an increase in the efficiency of locomotives could be secured by the use of pyrometers and the fact is realized by motive power officers. It remains to be seen whether the device will be genrally adopted or whether a long campaign of education will be required before it is recognized as a necessary adjunct to the superheater. The railroads are generally slow to adopt anything that adds to the cost of maintenance even though the increase is justified by the results obtained. It goes without saying that the pyrometers will require some attention, although the instrument now being offered for this purpose is very rugged and specially adapted for the purpose.

In considering the advisability of equipping superheater locomotives with pyrometers one important advantage secured by their use should not be overlooked. The pyrometer serves as a check on the operation of the locomotive and discloses conditions that could otherwise be determined only by very careful inspection. Mechanical department officers realize that due to hidden defects or improper operation the full benefit of the superheater is often not secured. The expense of examining locomotives every trip to determine whether draft appliances are in good condition, superheater flues clean and superheater unit joints tight would be prohibitive. The pyrometer will immediately show up any of these defects which reduce the degree of superheat. Furthermore, the improper methods of operation would be brought to the attention of the enginemen by the decrease in the degree of superheat and they would be enabled to correct such practices. In short, th pyrometer would lighten the work of the inspectors and locomotive supervisors and would be of great value in insuring proper maintenance and operation. The railroads spend large amounts in order that they may occasionally check the condition of the equipment. It should certainly prove advantageous to maintain such a device as the superheater pyrometer, which would disclose many important defects affecting the efficiency of the locomotive as soon as they occur.

Constructive Suggestions for the Mechanical Section

IN THE ADDRESS of W. J. Tollerton, printed in yesterday's issue, numerous subjects were mentioned to which the Mechanical Section might well devote its attention. Among the most important of these are two which have been touched on before, but should be taken up with renewed interest because under the present organization there is a better opportunity for dealing with them than has existed before. One of these is the question of engine terminals; the other the establishment of a co-operative research bureau.

It is 15 years since the Master Mechanics' Association had a comprehensive report or paper dealing with the design or operation of round houses. The conditions have changed greatly since then, and as stated by Mr. Tollerton the development of the locomotive has outstripped the improvements in the terminals. The need for improved facilities was very evident during the winters of 1917 and 1918, when great difficulty was experienced in caring for power at the terminals Since the introduction of the report prepared by the Operating Statistics Section showing the distribution of locomotive time it has become apparent that even under normal conditions motive power is delayed unreasonably long at many roundhouses. By comparison with the cost of locomotives the investment in terminals is small and efficient roundhouses, cinder pits and coal chutes will bring large returns in the increased efficiency of the motive power. Under the circumstances the question of terminal design and management should be an excellent subject for a committee report and since engineering as well as mechanical problems are involved the engineering Section of the American Railroad Association might be invited to co-operate in the preparation of a paper on these subjects.

Mr. Tollerton advocated the establishment of a co-operative research bureau, and the applause which greeted his remarks showed that the members were in sympathy with the project. Some of the investigations that should be undertaken by such a bureau were outlined in the chairman's address. The need is apparent, and if a practical working plan can be drawn up the American Railroad Association could probably be induced to provide the funds for carrying on the work. There is no reason why this should not be started without delay, as some of the universities having facilities for such work have in the past expressed their willingness to conduct investigations in co-operation with the railroads. The failure to establish a co-operative laboratory has been largely due to a lack of funds, but if the financial assistance of the parent association can be secured, the Mechanical Section will have an opportunity for carrying on research that should point the way to improved practices that will effect marked economies in operation.

Program For Today

9.00 A. M. TO 1.30 P. M.

Discussing of Reports on:	
Design, Maintenance and Operation of Electric Rolling Stock.....	9.30 A. M. to 10.00 A. M.
Individual Paper on "The Use of Bronze for Valve Snap Rings and Piston Surfaces, and Bull Rings in Large Cylinders, to Prevent Rapid Wear and Cutting of Cylinders and Valve Bushings".....	10.00 A. M. to 10.30 A. M.
By Mr. C. E. Fuller.	
Discussion of Reports on:	
Train Resistance and Tonnage Rating	10.30 A. M. to 10.45 A. M.
Subjects	10.45 A. M. to 11.15 A. M.
Powdered Fuel.....	11.15 A. M. to 11.25 A. M.
Resolutions, Correspondence, Etc...	11.25 A. M. to 11.35 A. M.
Auditing	11.35 A. M. to 11.40 A. M.
Unfinished Business	11.40 A. M. to 11.45 A. M.
Questions Proposed by Members..	11.45 A. M. to 12.30 P. M.
Closing Exercises	12.30 P. M. to 1.00 P. M.

Transportation Committee—Attention!

MEMBERS OF THE TRANSPOTATION COMMITTEE are requested to meet in front of Mr. Young's house on the Pier at 12 o'clock to-day to have a group photograph taken.

Section V, Transportation, Meeting

IN THE PARK AVENUE ROOM of the Marlborough-Blenheim Hotel this morning at 10 o'clock, there will be held a meeting of Section V, Transportation, American Railroad Association.

President of A. R. A. Congratulates Chairman Tollerton

W. J. TOLLERTON on Monday received the following telegram from R. H. Aishton, the newly elected president of the American Railroad Association: "My sincere congratulations on your election as chairman of the Mechanical Section of the American Railroad Association."

Presentation of Badge to E. H. Walker

AT THE MEETING of the Railway Supply Manufacturers' Association on Saturday, the presentation of the past president's badge to E. H. Walker was overlooked. The general committee of Section III, Mechanical, has extended an invitation to the Supply Manufacturers' Association to attend the Wednesday session near the close of the convention and the presentation ceremony will take place at that meeting.

Lost and Found

FOUND—R. S. M. A. badge, number 2775. Apply at Enrollment Committee office.

LOST—Badge No. 4026. Return to *Railway Age* booth.

LOST—A gold watch this morning on pier. Return to J. D. Conway's office if found.

LOST—Lace filet collar on pier this morning by Mrs. W. F. Robinson, Room 553, Dennis. Return to J. D. Conway.

LOST—Following badges in Secretary's office: 2775, 3679, 3922, 4209, 4334.

H. S. Wall, mechanical superintendent of the Santa Fe Coast Lines, lost a five-eighth carat diamond on the Pier. Finder will please return to *Railway Age* booth.

E. H. Bankard, Jr., on the Executive Committee

E. H. BANKARD, JR., who has made such an excellent record this year as chairman of the Entertainment Committee, was elected yesterday a member of the Executive Committee of the Railway Supply Manufacturers' Association. The vacancy which he was elected to fill occurred because George R. Carr, on being elected president of the association, had to resign his membership on the Executive Committee.

Push Repair Work on Cars

FRANK MCMANAMY, the assistant director of the Division of Operation, on June 20, sent the following letter to the regional directors:

"Confirming the understanding reached at our conference yesterday, arrangements should be made at once to condition freight cars to handle prospective traffic:

"1. Car repair forces should be put on full time at all points where a reduction in hours has been made.

"2. Car repairers who have been furloughed should be returned to service in all cases where they can be used to advantage. Such increases should be made at principle shops and at points where the work can be most economically performed.

"3. Where additional work is needed and penalty overtime can be saved thereby a second shift may be organized at shops where the facilities are such that it can be profitably employed.

"4. Special attention should be given to grain cars, coal cars and refrigerators cars in the sectons where such cars are most needed, so that the possibility of a shortage may be averted."

A Remarkable Miniature Car

THERE IS ONE CONVENTION EXHIBIT which is attracting a great deal of attention which is not designed as an advertisement for any manufactured product. Through the courtesy of the American Railway Express Company there is exhibited in booth 18 a model of a 50-ft. standard refrigerator express car built to one-eighth scale. The model was constructed by the American Car & Foundry Company. The underframe is of steel girder construction, the rivet heads in the model being hardly larger than the head of a tack. The body is of wood and is equipped with siphon ice bunkers with operative hatch covers and plugs. The inside is fitted with floor racks and the walls are insulated. The doors are fitted with a cam operated locking device and a miniature seal pin. The United States safety appliances have been applied to the car. Space will not permit of a description of all the details included in the model. It has all-metal trucks, hand brakes and brake rigging, air brake, signal and steam heat lines, couplers and safety chains and even a card holder on the side. The model will well repay inspection on account of its educational value and also as an example of high grade workmanship.

Secretary Hawthorne

IN THESE DAYS OF PERSONAL ACHIEVEMENT, when individual accomplishment cannot be hidden by a modest personality, the work of Secretary Hawthorne, of Section III, Mechanical, American Railroad Association, shines in no reflected light; and it is both the privilege and the pleasure of the *Daily* to call attention to his record of efficiency both before and during the convention.

Under the direction of Mr. Hawthorne the work of the secretary's office has been thoroughly reorganized in order to meet the new conditions involved in becoming a part of the American Railroad Association. This has been done with energy and tact and with a vision of the future possibilities of a larger mechanical association.

Mr. Hawthorne was born November 27, 1886, at Oleona, Pa. He received a common school and high school education and graduated from the Elmira Free Academy, Elmira, N. Y., June, 1905. He entered the service of the Pennsylvania Railroad at the Elmira shop as painter, in June, 1905, and was transferred to Baltimore as a car builder in the passenger car shop, November, 1905. While at Baltimore shop he was assigned to work in M. C. B. billing department. He was transferred to the M. C. B. clearing house, Williamsport, Pa., in June, 1910, and was transferred to the Pennsylvania Railroad M. C. B. clearing house at Altoona, Pa., June, 1914. While at Altoona he served on the M. C. B. shop Committee of the Pennsylvania Railroad and also the special investigating committee of the American Railroad Association. He was serving on this latter committee at the time of the death of Secretary Joseph W. Taylor.

The New Chairman

WHEN A MAN STARTS WORK as a machinist apprentice, rises to the position of master mechanic at the age of 26 and is made general mechanical superintendent of a road of 8,000 miles at 42 it is safe to say that he possesses unusual qualifications for railroad work. This in brief is the story of the career of W. J. Tollerton, who was elected chairman of the Mechanical Section of the American Railroad Association on Saturday. Mr. Tollerton might well be chosen as a typical representative of the higher officers of the railroads of this country. A tireless worker, he has risen to the position he now occupies by his ability and the force of his personality:

Mr. Tollerton was born in 1870 at St. Paul, Minn., and was educated in the public and high schools. He entered railroad service as a machinist apprentice with the St. Paul & Duluth, now part of the Northern Pacific, and subsequently became a fireman on the Chicago, St. Paul, Minneapolis & Omaha, since which he has been consecutively from 1890 to 1896 foremen and afterwards general foreman of the Union Pacific; from 1896 to 1903 master mechanic of the Utah Division, Oregon Short Line; from 1903 to July, 1906, master mechanic of the Idaho, Utah and Montana Divisions of the same road, with headquarters at Pocatello, Idaho; from July, 1906, to April, 1907, superintendent of motive power of the Chicago, Rock Island & Pacific in charge of lines west of the Mississipi river at Topeka, Kan.; from April, 1907, to May, 1912, assistant general superintendent of motive power of the Rock Island Lines at Chicago, Ill.; May, 1912, to January 1, 1913, mechancal superintendent, and from January 1, 1913, to date, general mechanical superintendent of the same lines.

The high esteem in which Mr. Tollerton is held was evidenced by the statement of J. E. Gorman, federal manager of the Rock Island, before the convention a few days ago, that he replied implicitly on Mr. Tollerton. It is characteristic of the new chairman to devote his energy without stint to whatever he undertakes and those who know him feel assured that under his direction the Mechanical Section will live up to the best traditions of the old associations.

The American Society for Testing Materials

THE PROGRAM for the first day's sessions of the American Society for Testing Materials was published in yesterday's issue of the *Daily Railway Age*. The program for the remaining sessions is as follows:

FOURTH SESSION, WEDNESDAY, JUNE 25, 10 A. M., ON STEEL AND WROUGHT IRON

Report of Committee A-1, on Steel.
Report of Committee A-2, on Wrought Iron.
Deep Etching of Rails and Forgings.
Modern High Speed Steel.
Some Fatigue Tests of Nickel Steel and Chrome-Nickel Steel.

WEDNESDAY AFTERNOON, JUNE 25
Committee Meetings

FIFTH SESSION, WEDNESDAY, JUNE 25, 8 P. M., ON CORROSION AND MAGNETIC ANALYSIS

Report of Committee A-5, on Corrosion of Iron and Steel.
The Influence of Very Low Percentages of Copper in Retarding the Corrosion of Steel.
Topical Discussion on "Magnetic Analysis."
This discussion will be formally introduced by several speakers under a number of titles.

SIXTH SESSION, THURSDAY, JUNE 26, 10 A. M., ON TESTING AND APPARATUS; RUBBER PRODUCTS AND TEXTILES

Report of Committee E-1, on Methods of Testing.
A Wire Testing Extensometer.
A Machine for Measuring Hardness of Thin Metal Sheets.
A Fatigue Testing Machine.
The Single Blow Notched Bar Impact Test as used in the American Industry.
Report of Committee D-11, on Rubber Products.
Steam Hose for Car Heating.
Report of Committee D-13, on Textile Material.

THURSDAY AFTERNOON, JUNE 26
Golf Tournament

SEVENTH SESSION, THURSDAY, JUNE 26, 8 P. M., ON MALLEABLE IRON AND NON-FERROUS METALS

Report of Committee A-7, on Malleable Castings.
Some Physical Constants of Malleable Cast Iron.
Report of Committee B-1, on Copper Wire.
Report of Committee B-2, on Non-Ferrous Metals and Alloys.
The Behavior of Wrought Manganese Bronze Exposed to Corrosion while under Tensile Stress.
Some Tests of Light Aluminium Casting Alloys: The Effect of Heat Treatment.

EIGHTH SESSION, FRIDAY, JUNE 27, 10 A. M., ON CERAMICS, LIME AND ROAD MATERIALS

Report of Committee C-3, on Brick.
Report of Committee C-6, on Drain Tile.
Report of Committee C-8, on Refractories.
Preventable Defects in Refractory Brick.
Report of Committee C-7, on Lime.
Report of Committee I-4, on Road Materials.
An Apparatus for Determination of the Breaking Point of Pitches.

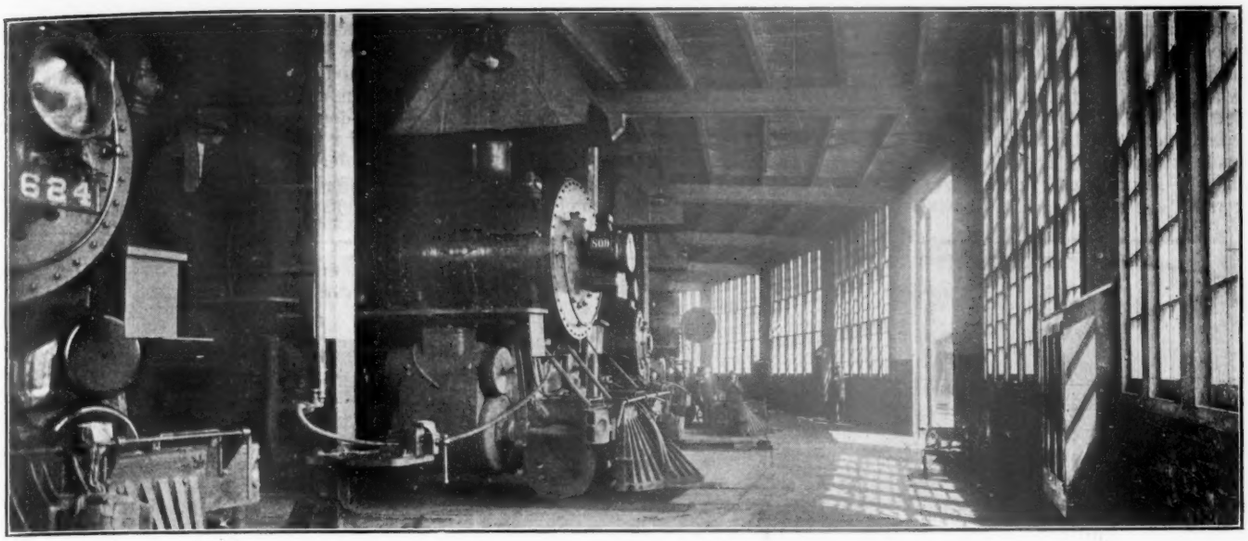
NINTH SESSION, FRIDAY, JUNE 27, 3 P. M., ON CONCRETE AND GYPSUM

Report of Committee C-2, on Reinforced Concrete.
Report of Committee C-4, on Clay and Cement Sewer Pipe.
Report of Committee C-11, on Gypsum.
Proportioning of Pit-Run Gravel for Concrete.
Theoretical Studies of the Surface Area Method of Proportioning as Applied to Concrete.
Modulus of Elasticity of Concrete.
Relation between the Methods of Curing Standard Concrete Specimens and their Compressive Strength at 28 Days.

TENTH SESSION, FRIDAY, JUNE 27, 8 P.M., JOINT SESSION WITH AMERICAN CONCRETE INSTITUTE ON CEMENT AND CONCRETE

Report of A.S.T.M. Committee C-1, on Cement.
Report of A.S.T.M. Committee C-9, on Concrete and Concrete Aggregates.
Report of A.C.I. Committee on Fireproofing.
A.C.I. Paper: Later Fire Tests of Concrete Columns.
A.C.I. Paper: The Strainagraph and its Application to Concrete Ships.
A.S.T.M. Paper: Effect of Fineness of Cement.
A.S.T.M. Paper: Cements Producing Quick-Hardening Concrete.
MISCELLANEOUS BUSINESS.

President Walker, of the R. S. M. A., has extended the privileges of the Million Dollar Pier to the members of the American Society for Testing Materials, whose badges will admit them to the exhibits until the close of the Mechanical Section Convention, at one o'clock this afternoon.



American Railroad Association, Section III, Mechanical

Fuel Economy, Maintenance of Boilers and Superheating Among Subjects Considered Tuesday

The convention was called to order by Chairman Tollerton on Tuesday morning, June 24, at 9.45 o'clock, and immediately took up the reports of committees, the first being that on Fuel Economy and Smoke Prevention.

Report on Fuel Economy and Smoke Prevention

W. Schlafge
Chairman

THE COMMITTEE HAS heretofore aimed to deal with the methods of firing and the means to be adopted for developing the required supervision, rather than with the details in design and maintenance which are subjects that more properly fall within the scope of other committee assignments. The situation immediately preceding the report of 1918 was so extraordinary and the need for economy so pressing, that a departure was made from the earlier policy and some consideration given the more general features attending the purchase, transportation and use of railroad fuel. This situation has been practically relieved so that now the importance of the subject arises from its influence upon operating expenses which have reached a point where they are absorbing the gross rail revenues for many roads.

There has been a steady increase in the total fuel cost to the railroads, chiefly caused by two factors—increased cost of production and increased consumption due to the natural expansion of traffic. The accompanying curve No. 1 exhibits the trend of total cost for the past nineteen years for which there are available figures. Comparison with curve No. 2 shows that while the trend of prices at the mines has been steadily upward, the increased total cost is chiefly due to increased consumption.

The increase was reasonably uniform for the ten year period ending with 1909 and subsequently it was more gradual. On a basis of the general trend of increase for the previous few years, a reasonable estimate of cost would have placed the total for the year 1917 at about $265,000,000, but the total actually amounted to $401,297,300.00, an increase of 55.9 per cent over the preceding year.

The official statistics for 1918 will undoubtedly disclose a total even greater, although there will be a substantial decrease in 1919 due to the greatly reduced tonnage handld and to the influence of a generally organized effort to promote economies in every possible manner. But the total will still be a vast sum, and since it represents approximately 14 per cent of the total operating expense it has assumed a greater importance than ever.

In view of the situation this committee is of the opinion that its report for this year may be profitably devoted to some consideration of the application of its previous recommendations and to methods for economy in the use of fuel for other than locomotive purposes.

In one of its earlier reports your committee provoked some criticism because of its suggestion that railroad fuel should be purchased to specification, but the past few years have furnished convincing evidence that this procedure is highly important if reasonable economies are to be effected. The advantage lies not so much in the purchase of fuel having the higher B. t. u. values as in the opportunity for selecting coal that can be economically burned under the peculiar conditions prevailing in locomotive service. A specification which limits the percentage of easily removable non-combustible produces economies in fuel, labor and transportation and involves no economic losses.

Action should be taken at no distant date to determine the most favorable conditions under which economical combustion may be obtained with various grades of fuel so that plant design and equipment may be made to utilize available supplies to the best advantage. Such an investigation would naturally include the difficult and varied circumstances attending locomotive service.

In the opinion of the commmittee public interest will ultimately require the exercise of reasonable efficiency in the use of fuel, which prompts a brief consideration of the conditions of purchase. Specifications should include the characteristics of the available supply with particular reference to the percentage of

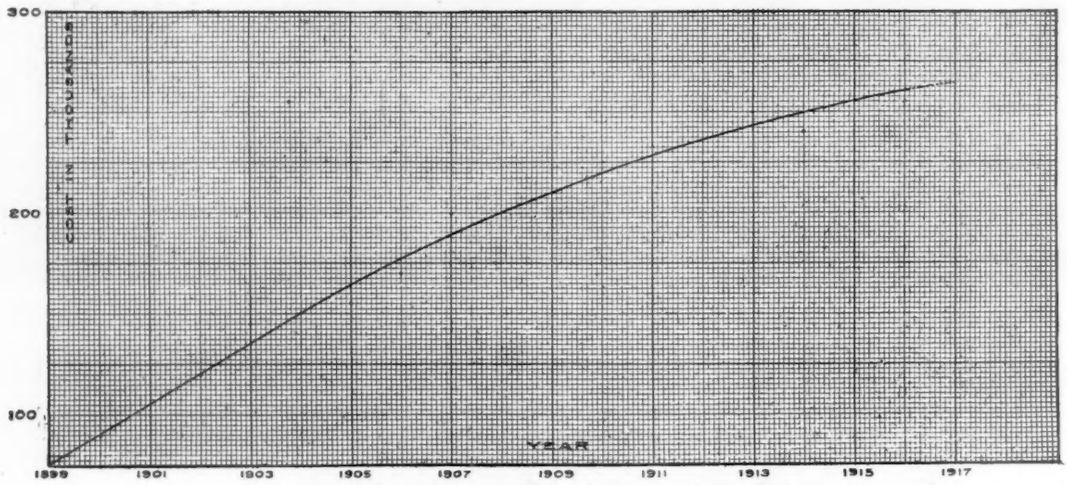
ash present, to its clinker forming qualities, and to its liability to spontaneous combustion. The size demanded for best results is also important and should be specified by the road supervision which should be familiar with requirements for the most satisfactory combustion conditions. It should be observed also that where these conditions cannot be obtained with one grade of coal, analysis will frequently develop that a suitable mixture may be secured with another grade. The character of the ash content exercises a great influence upon the combustion conditions since, under certain circumstances, the free burning of the combustible material is prevented and clinker formed over the grate surface, thus interfering with combustion by cutting off the air supply and not infrequently preventing proper operation of the grates to keep the fuel bed open.

There is also a common source of waste through clinkering coal. The ash constituents producing these cnditions are not only visible and mechanically separable, but may be intimately mixed with the combustible elements and, therefore, disclosed only by chemical analysis.

Reference has been made to the importance of properly grading the sizes of coal to insure the greatest efficiency. It is generally understood that existing locomotive operating conditions prohibit the use of slack, but not that different grades of lump coal have different evaporation values. This has recently been demonstrated at the University of Illinois in a series of tests with a modern Mikado type locomotive, the results of which are indicated below.

It should be said concerning these results that they are probably not generally applicable since they were made with Illinois coal from a single mine with one locomotive. It is not impossible that other coals with a locomotive having different stoker, grate, fire box or front end conditions might develop a different ratio, but the figures are useful in demonstrating the importance of the subject and emphasizing the necessity for ascertaining the conditions applicable to the different coals on each railroad.

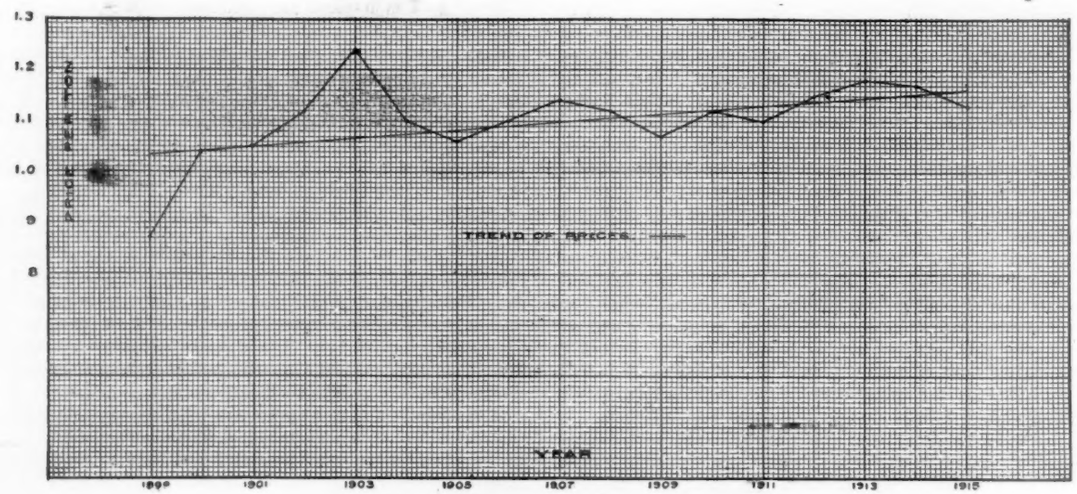
The foregoing observations are made for the purpose of emphasizing recommendations of your committee made in earlier reports concerning the desirability of creating an organized fuel department which should embrace the services of a chemist and an inspection corps whose attention could be devoted to those problems involving research and experiment and whose co-operation with the purchasing department would insure selection of those coals promising the greatest service value. Where the purchases are relatively small, a joint arrangement might be effected whereby the cost of this work could be distributed among several consumers. It is believed that the fuel Administration and Fuel Conservation Section have fully demonstrated the advantages of



Curve No. 1.—Total Locomotive Fuel Cost

EQUIVALENT EVAPORATION PER LB. DRY COAL

Size of Coal	Medium Rate Tests	High Rate Tests
3-in. by 6-in. egg	10.21	9.09
Mine run	10.12	8.66
2-in. lump	9.95	8.32
2-in. by 3-in. nut	9.90	9.11
2-in. screenings	9.25	7.43
1¼-in. screenings	8.47	7.06



Curve No. 2.—Price of Coal at the Mines

systematic inspection and analysis and a reasonable exercise of control over the supply. The benefits which have thus been received should be made permanent.

It may be well to describe a system in effect for some time on a large railroad, which has proven satisfactory and which has resulted in co-ordinating the various agencies responsible for the purchase and use of fuel. A chart of the organization appears in Fig. 1, and its functions are briefly described as follows:

The chemist and coal inspectors report to a staff officer of the Mechanical Department who is responsible for co-ordinating the laboratory and inspection work with that of the road supervision and the purchasing department. In this manner a proper anlysis of the varying conditions is insured and a check maintained upon shop maintenance and upon fuel distribution by the operating department.

Whenever purchase from a new mine is proposed analysis is made of a representative mine sample. From this analysis the general availability of the coal is determined and, if satisfactory, road tests are conducted to determine the service characteristics. As a rule the chemical analysis and physical inspection at the mine are sufficient to justify conclusions, but final acceptance requires favorable report by the road supervision. For the following regular shipments, samples from cars at destination are taken from time to time. These analyses are then compared with that of the original mine sample in order to determine whether the quality remains uniform. The inspector taking these samples effects contact between the road supervision and headquarters, interviews the road supervisors, investigates engine failures caused by poor coal to insure obesrvance of the schedule provisions and to see that the quality of the shipments is up to the standard; he checks manifests to insure proper distribution and the coal dock records to see that the right grade of fuel is used for the specified service. The other field inspectors are assigned to specific territories and live at a point central to them.

The duties of the field inspection force comprises not only the preparation and sizing at the mines, but should include all features affecting efficiency, cost of transportation and handling, such as inspection of the empty cars for foreign matter, particularly sandstone, cinders, gravel and similar materials likely to be mixed with the coal and dumped into the pockets. Experience has demonstrated that a quarter of a ton of such refuse is frequently found in empty cars consigned to the mines. The inspection should also cover defects in equipment and all conditions affecting the loading, unloading or loss of lading in transit frequently overlooked in routine car inspection.

Another feature of importance is the distribution of equipment to suit unloading conditions. The cost of unloading is now a large item and it constitutes a part of the total fuel charge. The field inspection force should be required to maintain a check upon these details and upon the scale and manifest weights to detect discrepancies, and to insure loading of equipment to the prescribed limit.

If the information collected by the inspection force is to be of value it must be promptly transmitted to headquarters, consequently, a daily report should be required covering all the features of inspection so that prompt steps may be taken in connection with any conditions requiring correction. One of the inspectors, designated as the chief, is held responsible for the work of the others and is expected to be informed on the technical features of the work so that the department will be assured of information concerning developments in the entire field of investigation concerning fuels, combustion and other related subjects.

Such an organization requires a high order of ability, but the cost involved is readily justified in view of the possibilities for economy presented. While varying circumstances will affect the number of men required in such a force, it is believed that, in general, a thoroughly satisfactory inspection service for a large railroad should involve an expense not exceeding one-tenth of one per cent of the fuel cost.

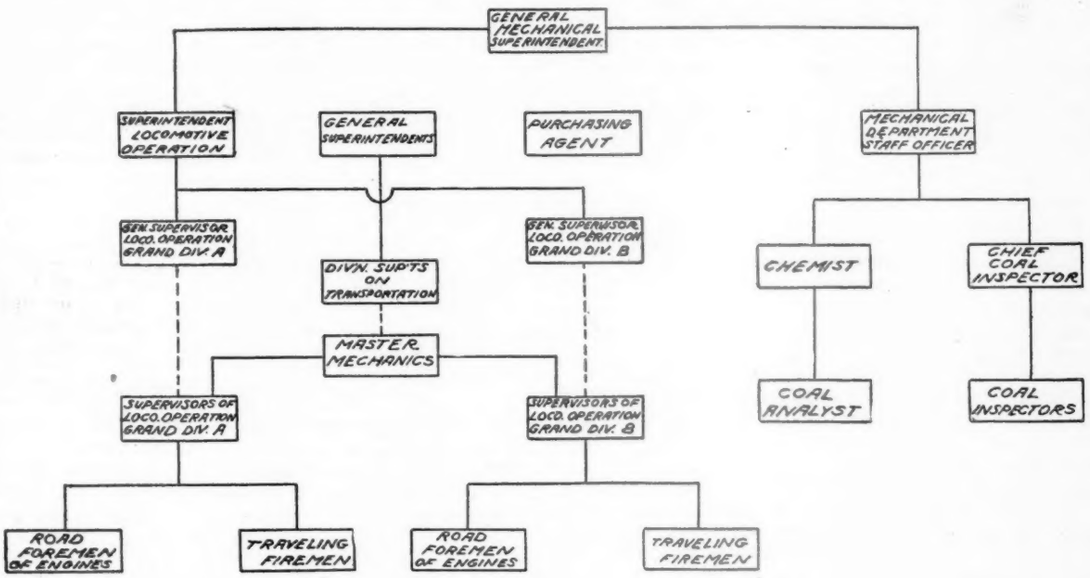


Fig. 1.—Fuel Department Organiz ation for a Trunk Line Railroad

The problem involved in the inspection, distribution and utilization of fuel is one in which each division of the operating department has some responsibility, and it is, therefore, advisable that the chief operating official should be fully informed as to the requirements, procedures and accomplishments of this branch of the organization. In the opinion of some, the head of the fuel department should report directly to the chief operating official, but, in view of the wide divergence of opinion on the subject, the committee is not yet prepared to make such a recommendation because it is thought that co-operation between the various operating branches will produce the required results, especially since fuel is now the second largest item of operating expense and, therefore, of prime importance to the transportation department.

The limitations upon a report of this kind do not permit further discussion of the features of inspection and we will now consider the locomotive and the influence of maintenance upon fuel consumption.

Since a knowledge of the nature of heat losses in locomotive service is essential to a proper appreciation of the possibilities for economy, it is desirable that brief reference be made to the

avenues through which heat is wastefully dissipated, which are as follows: 1. Steam leaks in fire box, superheater, front end or to the atmosphere. 2. Grate, cinder pit and stack losses. 3. Escaping steam through safety valves, unnecessary operation of auxiliaries, such as headlight generator, air pump, etc. 4. Unconsumed volatile matter usually denoted by excessive smoke. 5. Heat losses in escaping gases. 6. Radiation. These items are largely influenced by factors independent of operation and maintenance, but it is with the latter that we are now chiefly concerned and to which attention is directed.

Recent observation indicates that steam leaks are not receiving the attention demanded by the extent of losses involved. One remedy for this situation lies in o proper inspection of locomotives while under steam in advance of each boiler washing, this inspection to be followed by a check inspection after the locomotive is ready for service. This practice would insure reasonable freedom from leaks because excessive leakage rarely develops in the intervals between two boiler washing periods.

Large losses are sustained through faulty superheater maintenance. Pressure tests should be regularly applied to superheater units and steam pipe joints in order that defects may be located and corrected. Recent inspection on one railroad developed that out of 15 locomotives in service 11 had leaking superheater joints. This condition can virtually be eliminated through the observance of standard methods for the maintenance of units. This should include proper assembly with the required bands and supports in the tubes. Observation on several railroads shows that this feature is being neglected with the result that vibration opens the header joints, causing bad leaks in the smoke box and, frequently, costly damage to adjacent parts.

Faulty combustion, represented by unconsumed hydrocarbons and high combustible in the ash, is most frequently occasioned by improper air supply. For a given furnace and fuel, the excess air is fixed within comparatively small limits. An increase in the air supply reduces efficiency because of the loss in heating the excess, while on the other hand a decrease below the required percentage produces less complete combustion. Coals having low percentages of volatile matter require less excess air for nearly complete combustion than those having higher percentages of volatile. This not infrequently accounts for better results with one grade of fuel than with another.

In locomotive service the air supply is controlled by front end, flue, grate and ash pan conditions, which often do not receive proper attention from the designers. Many modern locomotives have grates with insufficient air-inlet openings, or with openings that readily become clogged, thus increasing the resistance to air flow. Attempts are frequently made to overcome this condition by adjusting front ends or reducing the diameter of the exhaust nozzle.

Many of the older engines are still equipped with ash pans having insufficient air openings, a defect readily detected with a U-tube draft gage. There should be no indication of vacuum in the ash pan.

It is highly important that the flues and tubes be free from obstructions which not only interfere with the air supply to the fire box, but reduce tube evaporating efficiency and superheater economy. The Fuel Conservation Section has recently pointed out that the fuel loss through drop in superheat with half the tubes stopped up may reach 24 per cent. In order that thorough and efficient cleaning may be assured, standard apparatus and methods should be established and suitable records maintained. The maximum interval in mileage or time between cleanings consistent with the requirements for different classes of power and service should be determined and flues thoroughly cleaned within these limits. Periodical checks by the supervising officers are required to insure proper work and continuous records.

Radiation losses have heretofore received little attention from writers on locomotive fuel economy and even less from those responsible for locomotive design and maintenance, as a casual inspection of any locomotive will disclose. It is estimated that the radiation from each square foot of surface carrying 200-lb. perature wastes 1000 lb. of coal per year. This loss increases rapidly with decreasing temperatures, certain weather conditions and rapid circulation produced by moving locomotives. The average locomotive has approximately 100 sq. ft. of such exposed boiler and pipe surface, easily representing an annual loss of $150 to $200. This can be substantially reduced if cylinder heads, steam pipes and fire box surfaces are properly insulated. For this purpose it is recommended that magnesia-asbestos or hair felt be used and that it be not less than 1½ in. in thickness except for small pipes where ¾ in. is sufficient.

Fire boxes may be covered by removable sections where access to staybolts is required. These practices, once somewhat general, have been neglected because of the maintenance problems introduced with modern power.

A common source of loss of power and combustion efficiency arises from frequent unnecessary changes in the dimensions or adjustment of front end appliances. Standards suited to local conditions for each class of locomotive should be determined and maintained, and periodically checked by the inspection force. The common practice with respect to a poor steaming locomotive, for which the cause is not readily discernible, is to alter some of the front end details, whereas, proper investigation usually discloses a leak in some of the joints, frequently between the front and the ring or around the outside steam pipe joints. As an overdrafted locomotive produces air, spark and back pressure losses, the importance of maintaining standard front end details may be understood.

In its last report the committee briefly covered those features of maintenance that contribute largely to power and fuel losses, but the work of the Fuel Conservation Section has demonstrated that two other appliances are exerting an appreciable influence upon locomotive fuel losses, the power reverse gear and the pneumatic sander. There are some power reverse gears in use that, not being positive, permit "creeping" while the locomotive is in operation, thus increasing the cut-off and decreasing efficiency. It is recommended that all such gears be modified so as to permanently correct this defect and that particular attention be paid to the maintenance of valves and packing to insure proper operating conditions.

The losses occasioned by poor sand and defective or inoperative sanding appliances are greater than commonly supposed and arise chiefly through failure at critical points, necessitating stopping, taking slack and doubling hills. The committee recommends the adoption of suitable specifications governing the purchase of locomotive sand which, by establishing reasonable limits for silicon content, will insure a suitable quality. To make the material effective, the sand pipes should be firmly held over the rail by substantial clamps not less than ½ in. by 2 in. in section, attached to the extreme lower end of the pipes. With the adoption of these provisions the prescribed daily or trip inspections should insure the desired sanding efficiency.

Previous discussion has been confined to the influence of the locomotive and its details of construction, maintenance and operation upon fuel consumption, but it may be well to mention the fact that car equipment also exerts a large influence upon the problem. While any defect contributing to increased resistance produces a corresponding increase in the fuel required, perhaps the most general features are defective brakes and air leakage caused by defective hose and gaskets. The leakage limits for freight trains established by many railroads should be generally adopted and consistently maintained. The committee recommends that they be given official recognition and incorporated in the air brake rules now the standard practice of the section.

While the opportunity for the greatest savings occurs on the road, there is an aggregate annual loss now amounting to millions arising from locomotive fuel consumption that is occasioned through the limitations imposed by service conditions. The fact is that irregular demands upon the locomotive render side track and terminal economies of the highest importance.

A large part of the terminal losses arises from maintaining locomotives under steam when not required for early service and from unnecessary cleaning or removal of fires. Where locomotives are not likely to be required for service within twenty hours, as frequently occurs on Sundays or holidays, or under special conditions arising from variations in operation incident to reduced business, fires should be drawn. Under all circumstances grates and stacks should be covered to prevent the cooling effect of air circulation through the fire box and flues. This suggests the frequent waste observed through faulty methods of firing up, resulting in the loss of green coal through the grates either because they are defective or the openings are large enough to permit the green coal to fall through. Observation of recently prevailing methods discloses that enough coal is fre-

quently wasted in this manner to haul 1000 tons one mile on the average railroad. Grates should be covered with shavings or wood before coal is applied, which will not only minimize the loss mentioned, but reduce the quantity of coal otherwise required in kindling fires.

Side track losses arise from excessive draft which should be regulated by means of the fire door. Another factor in this connection is the influence of the superheater damper which is frequently tied open, a practice that should be discouraged because of its influence upon maintenance as well as upon fuel consumption.

Cinder pit operation offers much greater opportunity for fuel economy than is generally recognized. Recent investigation developed that the combustible content of locomotive cinders at certain terminals averaged 35 per cent by weight. In other words, every car of cinders contained more than a third of a car of coal. It is at present impossible to avoid large losses here, but they may be mimimized through the co-operation of engineers, firemen, hostlers and ash-pit foremen by careful firing before engines reach the pit avoiding the application of green coal immediately before fires are cleaned.

This suggests the service that competent supervision may render on the ash pit in cleaning fires promptly, moving locomotives as soon as ready, in careful cleaning of fires to properly remove ash and clinker without waste of fuel, in preventing the excessive use of the air pump and steam blower and in maintaining co-operation with the roundhouse in order that no fire shall be dumped unnecessarily and no fire cleaned that will require subsequent dumping. The ash pit foreman should be provided with a copy of the monthly boiler list and see that fires are dumped as the engines pass over the pit.

The coal pocket foreman should be furnished with a schedule of coal required by locomotives in each class of service and should be charged with the responsibility for observance of the schedule. The Fuel Conservation Section estimates that at least 100,000 tons of coal, unnecessarily carried on engine tenders, is being transported 100 miles every day at a total expense for fuel alone equivalent to 1000 tons per day. The schedule should also indicate the kind of coal required for different classes of locomotives and assignments so that the better grades may be employed in the heaviest service.

The extent of the possible terminal losses suggests the desirability of an accounting system that will distinguish between the fuel consumption of locomotives in the hands of the mechanical and the transportation departments. Such records would readily disclose uneconomical practices and permit their prompt correction. The road performance should be compared with predetermined figures based on an estimate and trial under average conditions.

While the responsibility for fuel conservation rests in a large measure upon the mechanical department, there are features of operation affecting the problem that are under the immediate control of associated departments whose interest is essential to many economies that are possible only through improved efficiency in daily routine. This includes prompt dispatching of locomotives and trains, proper adjustment of tonnage, proper make-up of trains, prompt completion of station work and the elimination of delays in the movement of ash pit and coal cars.

Maintenance of way and signal department officers can also render effective service in the cause of fuel economy by eliminating, as fas as possible, the necessity for stopping or reducing the speed of trains because of prolonged slow orders, the unnecessarily prolonged display of caution flags or inoperative signals. This department is also directly responsible for lighting and pumping-plant operation and should eliminate fuel losses through radiation from exposed surfaces and the steam leaks that are frequently characteristic of these isolated plants.

Locomotive fuel constitutes about 88 per cent of the total railroad consumption, and, therefore, offers the greatest opportunity for conservation and economy, but the remaining 12 per cent represents the very substantial sum of $45,000,000 on the 1918 basis, an amount approximating half the total fuel cost for locomotives ten years ago. Of this total the largest percentage is represented by power plant consumption to which the remainder of the paper will be devoted.

Questions of relative economy in the purchase of power or its generation in privately owned plants are important, but do not fall within the scope of a paper which deals with the problems of operation rather than design, and consideration will, therefore, be given to those details susceptible of correction in existing plants.

The inefficiency in the ordinary railroad stationary boiler plant arises from equipment, maintenance and operation. Large losses are frequently encountered because of insufficient or inefficient equipment. Investigation has developed frequent instances of low rates of evaporation in very infficient plants caused by an attempt to force boilers above their normal capacity. This is a frequent accompaniment of the discarded locomotive boiler which is always uneconomical for stationary purposes. In one instance of recent occurrence, a locomotive boiler in stationary service, consuming seven tons of coal per day, was replaced by a return tubular boiler which effected a saving of three tons per day under the same service conditions.

Many stationary boilers are not provided with dampers in the uptake, and yet draft regulation should be obtained with dampers and the draft should be varied to suit the rate of combustion, which is proportional to the load. Maximum efficiency is attained when the proper draft for given rates of combustion under given condition is established by suitable tests. The influence of proper draft regulation is plainly indicated by the curve marked Exhibit *A* from which it will be observed that under the conditions represented, damper regulation effected an average saving of 9½ per cent.

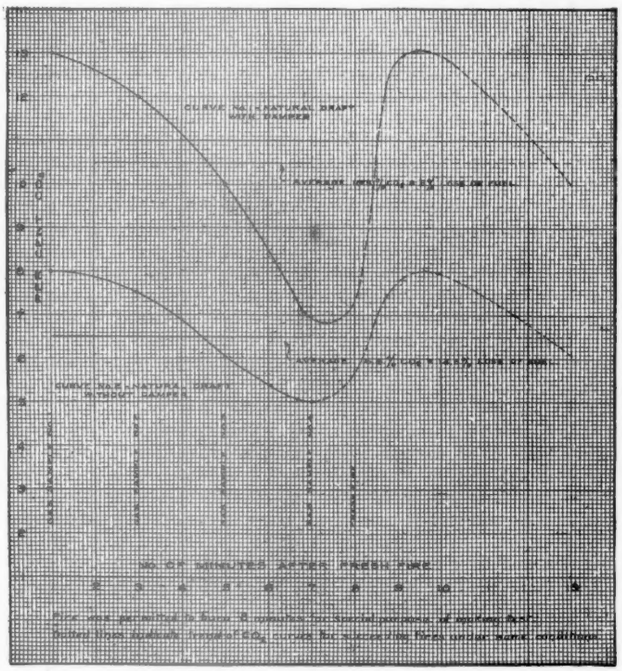


Exhibit A.—Variation of Percentage of CO_2 in Flue Gas Stationary Plant

Feed water heaters are not economically employed and yet the conditions prevailing in practically all railroad power plants will permit their use for eight months in the year. When it is considered that uuder average conditions an increase of 11 degrees F. in the temperature of feed water effects a saving of about one per cent in fuel consumption, the loss from free exhaust stam is plainly evident. There is no more immediate and effective means of economy than through feed-water heating.

One other prime factor in power-plant economy lies in the disposition of exhaust steam other than for feed-water heating purposes. This feature would not be lost to view if the engine portion of the plant were considered, the auxiliary and mechanical power a by-product. Under average conditions the heat consumption of stationary engines does not exceed 15 per cent of the total heat generated, the difference being represented by the heat of the exhaust. In practically all railroad shops, therefore, the heating requirements should be satisfied with exhaust steam, and in large plants the condensate should be returned through a suitable vacuum system. The outside purchase of

power and the use of high pressure steam for heating purposes is an unwarranted extravagance.

Experience has convinced the committee that the largest losses usually encountered in the operation of stationary boilers on railroads are included under the following headings, which are enumerated in the order of frequency and importance. 1. Leaky settings and stack connections. 2. Poor firing. 3. Radiation from uncovered surfaces. 4. Dirty flues.

Leaky settings produce excess air in the combustion space, although this may arise from other causes. The importance of this common source of inefficiency will be understood from the fact that boiler efficiency falls off in almost direct proportion to the percentage of excess air, and this not infrequently produces a loss of 40 per cent. Brickwork settings are sure to develop cracks in addition to which the porous character of the brick permits air infiltration. All exposed brick settings should at least receive a coat of a good plaster sealing compound; a ½-in. covering of magnesia-asbestos cement, followed by the sealing compound, is even better. Frequent leaks are found around stack connections, plates, dampers and doors, all of which influence the draft and reduce boiler efficiency. These parts require occasional inspection to insure a high order of maintenance.

Poor firing includes too thick or too thin a fuel bed, accumulation of clinkers, too frequent shaking, uneven distribution, permitting holes to develop, improper manipulation or neglect of dampers and carelessness in fire cleaning. Correction of these faults is a matter of analysis, education and supervision. It should be observed, however, that the economies of the best equipment may be lost in poor boiler room practice.

Radiation losses are usually considerable and nearly always neglected. At 100-lb. steam pressure and 70 degrees F. atmospheric temperature, the loss in radiation amounts to 718 lb. of coal per sq. ft. of uninsulated surface per year. It is, unfortunately, common practice to burden railroad shop boiler plants with a multitude of accessories usually involving large heating loads. It is certainly economy to centralize steam production, but economical steam distribution is a matter too frequently left to the division plumber or the shop pipe foreman, who may be masters of the technique of thei rtrade, but to whom lost B. t. u.'s are of no particular interest. The surest evidence of this statement lies in the appearance of bare ground in winter over the average buried steam pipe. Plain, unprotected, asbestos covering on an underground steam pipe may be expected to become a surface condenser of large capacity. The committee recommends the adoption of specifications for pipe coverings suitable for superheated and saturated steam and hot water, and also for water-proof underground coverings for low pressure lines.

Clean flues and boilers are a matter of standard practice and organization. In plants having no engineer, the responsibility for cleaning flues and washing boilers at the prescribed intervals should be placed upon one of the firemen, and he should be followed up by the general supervision.

Auxiliaries are frequently neglected, especially in the smaller and older plants. Blowing rod packing, excessive water-pump slippage and leaking steam-pipe joints are all too commonly in evidence where it is unnecessary to maintain a suitable relation between input and output. The losses outside the plant are also much greater than usually supposed, particularly in compressed air lines. It is estimated that the cost of air, compressed in a modern plant, approximates 10 cents for each 1000 cubic feet of free air used, and yet the waste in many plants is enormous. Reasonable economy requires that a periodical inspection of air losses shall be conducted and leaks in pipe lines, valves and hose promptly repaired. Once each week is not too frequent for inspection in the average shop.

Preparation of systematic records is essential to every well operated plant. The possibilities should be developed through suitable experiments, and standards once established should be checked with the daily operation. Such records should be made to correspond with the available equipment, and, for smaller plants, may be very simple. The results for a general division of a railroad may be tabulated and a rating established which will stimulate competition. For this purpose plants having the same general facilities should be grouped by classes in order that the ratings may be comparable. The attached forms, *A* and *B*, are offered as a simple basis for rating plant maintenance.

Stationary power-plant operation may be reduced to a reasonably exact basis and the best results are attained when the equipment is planned for the required service. Results may then be obtained upon a basis corresponding with reasonable exactness to a predetermined production cost, but the variables in the operation must be worked out to produce maximum economy for various rates of output. These are problems requiring skill and experience, and should be intrusted only to qualified engineers. The committee repeats its recommendations of last year that mechanical stationary power plants be placed under the responsible supervision of one man, whose time on the larger systems can profitably be devoted to the problems and economies in steam generation and utilization.

In conclusion, the committee recognizes that without any attempt at research or experiment, it has been necessary to sacrifice originality of subject matter. But if many of the things mentioned have long been familiar to mechanical department officers, perhaps their present existence is the best of reasons for their consideration at this time. It is reasonable to assume that neither the cost of mine production nor that of transportation will be appreciably lower in the immediate future, so that economy in consumption assumes an importance relatively greater than ever before. But, it may be asked, what shall be done to realize the economies admittedly so necessary. The answer is that the first requisite is full knowledge as to the extent to which wasteful practices prevail, which should be determined by careful survey. Remedial measures will frequently involve mechanical equipment requiring appropriations, but the chief problem is one of efficient operation and effective supervision. The results depend upon maintaining an enthusiastic interest on the part of those responsible for the use of fuel and the

"FORM A"

RANK OF POWER PLANTS

Rank determined from the standpoint of Fuel Economy. Size of plants not considered.

Rank based upon consideration of the following:

1. Combustion efficiency.
2. Condition of plant, including air-tight boiler settings; dampers and damper operators; grates; scale; soot; engine-room equipment; steam and air leaks and pipe insulation throughout shop facilities.
3. Interest of local forces in plant and effort to follow recommendations for operation and improvement.
4. General appearance (with due consideration of conditions).
5. Need of general overhauling.
6. Quality of fuel furnished.
7. Efficiency of firemen.

(Master Mechanics will report by mail improvements made from time to time which will affect standing of plants they supervise.)

KEY TO RANK

A—Excellent	91 per cent to 100 per cent.			
B—Good	71 per cent to 90 per cent.			
C—Medium	51 per cent to 70 per cent.			
D—Fair	26 per cent to 50 per cent.			
E—Poor	0 per cent to 25 per cent.			

Rank A	Rank B	Rank C	Rank D	Rank E
None	A 88 prct F 80 prct	K 67 prct P 54 prct	T 30 prct	None
	B 82 prct G 78 prct	L 65 prct Q 51 prct		
	C 81 prct H 76 prct	M 63 prct R 51 prct		
	D 81 prct I 74 prct	N 61 prct S 51 prct		
	E 81 prct J 73 prct	O 54 prct		

Carbon copy to Gen. Officers Asst. Gen. Mgrs., Mech. Supt., Eng. M. of W., Supvr. Fuel Econ., Supt., M. M., Power Plant Mgr.

Form B.

WORKING CHART. Key to numbers appears on FORM A.

Location of Plant.	No. 1.	No. 2. Plastic Cement.	Cracks.	Fire Doors.	Dampers.	Damper Operators.	Grates.	Steam and Air Leaks.	Scale.	Soot.	Leaks in Engines and Pumps.	Pipe Insulation Entire Plant.	Baffles.	No. 3.	No. 4.	No. 7.	Total Score.
Potential %	0	2	6	3	15	10	2	3	7	5	2	8	5	5	2	25	100
Boston....	good	2	6	3	15	10	1	2	5	4	2	0	none 5	0	1	20	76
Los Angeles	fair	0	6	3	15	0	stoker 2	3	6	5	2	8	with 3	5	2	15	75

elimination of wasteful practices. And the interest and enthusiasm must begin at the top and permeate the entire operating organization if the maximum efficiency is to be attained. The great difficulty, on a railroad, lies in the tendency to relaxed effort, besause of the routine involved, but this is a subject demanding sustained and interested support from the chief operating officer to the fireman and the roundhouse man.

The report is signed by Wm. Schlafge (Chairman), Erie; W. H. Flynn, Michigan Central; Robert Quayle, Chicago & North Western; D. J. Redding, Pittsburgh & Lake Erie, and W. J. Tollerton, Chicago, Rock Island & Pacific.

Discussion.

Mr. Schlafe: We have received, too late to be embodied in the report, a suggestion made by a member of the Fuel Conservation Board, and we desire to offer the following:

"Since the advance copies of the report have been distributed, it has been suggested to the committee that there may be possibilities for fuel economy, in stoker-fired locomotives, through screening out a portion of the slack.

"There can be little doubt that the rate of evaporation would be improved if this was done, but the net efficiency would obviously depend upon the mine cost of the fuel so prepared. The committee suggests that the subject is sufficiently promising to justify investigation by the railroads having stoker equipment, in order that immediate advantage be taken of any economies that can be realized in this manner.

"Attention is directed to a typographical error appearing in Curve No. 1 of the report, the ordinates of which should be expressed in millions instead of thousands."

Mr. Woodbridge (Supt. Fuel Conservation, U. S. R. R. A.): I feel that the members of this association should take home the lesson that Mr. Tyler gave us yesterday, relative particularly to new devices. I was very sorry that the subject of weighing the coal on a tender was passed over so hurriedly. There is no question whatever but that accurate records of the consumption on individual engines will result in greater fuel conservation than any other one thing. Everyone knows that the experiments that have been performed in the last few months of counting scoops of coal, or estimating the coal placed on tenders, unsatisfactory as they are, have produced a rivalry among engine crews that has resulted in a tremendous economy in fuel. I sat in this convention in 1906 and 1907 when H. H. Vaughan pleaded with you to put superheaters on your locomotives, and most of the things he said fell on barren ground. Five years after that Russia had six per cent of her locomotives equipped with superheating apparatus, and you had six-tenths of one per cent equipped. A proper weighing device on the tender to tell what coal was being used would result in fully as great a reduction in the fuel consumption as the superheater, and I commend that thought to your very serious consideration.

I want to read a paragraph in this paper here, and to commend it to you: "The greatly increasing coal consumption and the present growing importance of conserving this indispensable factor in our economic life prompts your committee to say that in its opinion action should be taken at no distant date to determine the most favorable conditions under which economical combustion may be obtained with various grades of fuel so that plant design and equipment may be made to utilize available supplies to the best advantage." And just following this, "In the opinion of the committee public interests will ultimately require the exercise of reasonable efficiency in the use of fuel, which prompts a brief consideration of the conditions of purchase."

It seems to me there is a slight inconsistency in two paragraphs, and it is a mighty important matter. I also want to read these two paragraphs: "The problem involved in the inspection, distribution and utilization of fuel is one in which each division of the operating department has some responsibility, and it is, therefore, advisable that the chief operating official should be fully informed as to the requirements, procedures, and accomplishments of this branch of the organization. In the opinion of some recognized authorities, notably the chief of the Fuel Conservation Section, the head of the fuel department should report directly to the chief operating official, but in view of the wide divergence of opinion on the subbject, your committee is not yet prepared to make such a recommendation, because it is thought that co-operation between the various operating branches will produce the required results.

There is no question about that, but you can't get that co-operation unless you have, as is stated in the report, the results dependent on maintaining an enthusiastic interest on the part of those responsible for the use of fuel and the elimination of wasteful practices. The transportation department can waste more coal than all the firemen in this country can save, and you must have co-operation. The interest and enthusiasm must begin at the top. You cannot get the co-operation that you must have unless you have at the head of the organization some one connected with the chief operating officer who is willing to assist you in checking the other fellows—maintenace of way men, for example, slow orders and so on.

Mr. Bentley: Some question was raised about the sandpipes not being in line with the rails. One of our men squared the ends of the sandpipe and put a square clamp on so that it is impossible for the pipe to turn. The covering of the outside steampipe is something that has given us a lot of concern, but I believe we have finally arrived at a solution of the difficulty. We are putting a shoulder on the casting that goes into the smokebox, putting a collar around the steam pipe about eight inches below that and covering the intermediate space with a sheet iron covering, which apparently is an air-tight proposition.

D. J. Redding, (P. & L. E.): One item in the report which perhaps does not receive enough consideration is the matter of sanding equipment. I know of some tests conducted some time ago to find out what sanding locomotives meant, and all of the standard makes of sanders were tested. We found as much as 500 per cent. difference in the amount of air required, as between one sander and another, to put sand on the rails.

We also found that no one was paying particular attention to sanding and its cost, and the cost of the operating mechanism to handle the sand. The sand, at least on that railroad, cost more than the oil for locomotives, and the oil was given a lot of expert attention.

W. J. Bohan (N. P.): Approximately one-third of the coal consumption of the country is credited to the railroads. We are apt to confine our coal conservation too much to our locomotives, and do little or nothing towards coal conservation in our stationary plants. Probably one of the most wasteful things we have is the ordinary round-house plants, with condenser systems, consisting of the blower outfits used in roundhouses and inefficient transmissions for operation of our shop tools. Little or no attention is given to what might be done in purchasing power from outside concerns.

Railroad people might well give consideration to the acquiring of accurate data on their power plants, to determine at what rates they could afford to buy current. Some recent investigations showed that from 30 to 50 per cent. can be saved in some instances, in the purchase of current at proper power rates. The public utility man has not recognized the possibility of securing this business to a very great extent, and it is time that we started an educational programme with him so that he will.

I would like to ask if the committee has considered that one part of its work is to look into this very important matter of the purchase of power and the shutting down of the local steam plant.

B. J. Feeny, (Supv. Fuel Conservation Sec. U. S. R. A.): Some reference was made to the difference in opinion as to who was to handle the coal on the railroads. If you have any difference of opinion as to who will be responsible for it, you do not understand how big a problem it is. If the fuel used on the railroads in this country in 1918, was put in fifty-ton cars and moved at the rate of sixty miles an hour, it would require twenty days and twenty nights for that amount of fuel to pass you, and when put in the storage yard, it would be necessary to have a yard one hundred miles long with two hundred and eighty-eight tracks and this coal is costing the railroads approximately $1,500,000 a day.

There should not be much difference of opinion as to who should handle the fuel problem. Some one should be responsible for the handling of fuel on the railroads, because we know that there is a great waste of fuel.

You would get more results out of the use of weighing apparatus, if there is such a thing, than you do out of the use of superheaters. It is, maybe, we are not getting the full results from the super-heater, but this is due to neglect.

Faulty workmanship on locomotives is responsible for a large amount of waste. If you will go home and took down ten in-

dividual smokestacks you will see what faulty work is being done in the shops of the railroads.

On some stacks I have seen table plates that you could put your hand through, and these locomotives were inspected every day. We inspect the netting for fire protection, but that is as far as we go unless there is a loose nut or bolt that can be plainly seen.

The Russian locomotive came to us and there was a diversity of opinion as to the front ends. These locomotives had as many changes made in them as the number of railroads they were put on. One railroad changed the grates of these locomotives, put on a standard nozzle and made the best records in fuel consumption of any engines on that division.

We have learned from the Russian locomotive front ends that when the gasses reach the end of the flue they are not restricted, but pass right through the stack. On a great many of our older locomotives in this country we have the draft sheet set so close to the flue sheet that the gasses and cinders strike this plate so hard as to cause them to rebound and pass back through other flues. This is responsible for the hot fire doors we have heard so much about.

There is too great a variation in the grates on the different locomotives. One railroad will operate its locomotives with 25 per cent of air opening grates, and another railroad in the same vicinity using the same coal will use a grate with 50 per cent opening.

On a great many of the locomotives there is fifty lineal feet of exposed steam heat pipe from the source in the cab to the rear end of the tender and we run this equipment through zero weather and wonder why the train-line freezes up. If we will give the same attention to the fuel on locomotive tenders that we give to the lubricating oil on locomotives we will make progress.

On one railroad in the southern region a man was put on for the purpose of saving fuel and in looking over the record. I find that that road saved $116,000 the first three months of 1919 as compared with the first three months of 1918.

L. P. Streeter (I. C.): Reference is made to the importance of reducing the permissible air leakage limits for freight trains. That matter was recognized by the Fuel Administration last year, and it requested the Air Brake Association to write rules that would eliminate or reduce that leakage. A committee was appointed, of which I was chairman, and the result was the issuance of Fuel Conservation Circular No. 13, over the signature of Eugene McAuliffe, and a marked improvement followed. I have noticed, however, a lapse in the efforts made on the part of the men since the armistice was signed. Possibly they thought that it was not so important to continue the strict observance of these rules as it was during the war.

It is important that every one of us should make the effort to keep that circular before all concerned.

Leslie R. Pyle (Supervisor of Fuel Conservation): You gentlemen think probably that the Fuel Conservation Section is doing a lot of talking, but I want to say a few things, and they are things connected with the mechanical equipment, either in the locomotive or stationary plant.

In the last year I have had hundreds of meetings in the Central and Western regions, and I have made a number of inspections. I see things that lead me to believe that there is no real heart interest in fuel economy. The railroad companies in the last five months of 1918 and the first six months of this year saved nearly $10,000,000 in fuel, a saving on practically all railroads, but we cannot stop with what we have done.

All of the work you gentlemen have done with the assistance of your force, and the transportation people as well, show the new conditions that exist today. A master mechanic said to me a few days ago: "Mr. Pyle, after you have seen what we have done, you might give us some credit for it." It is not the credit we are looking for, but to save the dollars and cents of the railroad company, and when we are wasting fuel to-day to the extent of hundreds of dollars' worth around our terminals, there is no use in talking of what we have done. What is needed to-day in order to continue savings, and increase them, is for the people who are responsible for these conditions to take the proper interest in them and see that the saving is made. When I can go to a terminal and casually discover eight or ten places where steam is being wasted, and fuel wasted, it shows that the conditions are not what they should be.

I can go to any number of roundhouses and find leaky steam lines with the blowers covered with burlap to cover up the leaks. I can find air compressors that are compressing no air, but are running, and some one around the shop will see this, but nothing is done about it.

I have read the minutes of fuel meetings where the road foreman will get up and say there is nothing left to do at a terminal to save fuel, and the superintendent will say that he could not save ten dollars worth a month on his division. What he says indicates that in his mind there is no necessity for further effort to conserve fuel.

Every one should feel that it is his duty to save fuel. When you go back into the roundhouse see if there are not a number of these things that require attention. Sometimes when I talk to the foremen about steam and air leaks they say they cannot get the men to fix them. You cannot expect any man working for you to do any more than you do, and if you see burlap tied around a steam pipe to prevent a leak, or to lessen a leak, and you do nothing to have that difficulty remedied, you cannot expect the men to take any interest in it.

You can bring about fuel economy and get your men to take the proper interest in that subject, by setting them the example and seeing that these things are properly card for.

The last two pages of the report contain diagrams giving the results of rating of power plants, showing the attempts made to bring about the efficient operation of stationary plants. This association recommends standard practices, and while this report does not recommend the standardizing of this practice of rating power plants, yet I would like to recommend that this rating be standardized on all railroads, because this system has worked a wonderful change in the power plants on the railroad on which it was developed. Before this system went into effect, due to the apparent lack of interest on the part of the company, one of the power plants was rated at 68 per cent, the best mechanical plant on the railroad. In the last report that plant is rated at 91 per cent. It would not have been 91 per cent had it not been for this report going out to the superintendent, showing that there was room for improvement in the operation of a plant. If it had not been for this system of rating the terminal probably would still be 68 per cent. When you point out an evil to a man who is responsible for it, he will give his attention to overcoming it. All that we need is to have a regular inspection, and not simply say that the fuel is being wasted, but do something to prevent that waste.

C. A. Bingeman (P. & R.): We have given the matter of fuel conservation some careful consideration on the Philadelphia & Reading, both from the standpoint of the locomotives and of the stationary power plants. It is not only a matter of seeing the things that require attention and co-operation on the part of all parties concerned, but it is a matter of a certain amount of money investment, in many cases, in order to achieve fuel conservation in these plants. Many of the old plants have grown up from year to year under the old practice of using locomotive boilers for stationary service at roundhouses, which practice everybody knows is wasteful in fuel. They do not have the proper size of chimneys, in many cases, no proper regulators, in some cases no damper provisions whatever and no gages so that the firemen ma yknow just what his combustion conditions are at any time. We have found cases where grates were not properly proportioned. All of this can be cured with little expense, after the conditions are determined by making tests with suitable appliances.

A great amount of fuel can be saved at all of these plants if the management will give co-operation, from a financial standpoint, to the motive power department which has charge of these various plants and will give attention to its recommendations.

T. A. Barton (D. L. & W.): I have had a great deal of experience in sanding locomotives, and I find that, in a great many cases, there is not enough attention paid to the quality of the sand put on the locomotives. In many cases you will find the sand pipes, sand traps and sanding apparatus all hammered to pieces, and it is due to no other cause than the material put in the sandbox.

Robert Collett (Fuel Cons. Sec., U. S. R. R. A.): This very valuable report marks a very decided step in fuel conservation generally. It is a big thing for the motive power men and the mechanical organization represented by this association, which is the mouthpiece of the people who use the fuel. After all, it is

the mechanical department that uses the fuel, and the thing which is a big text is the paragraph "that the chief problem is one of efficient operation and effective supervision, and the results depend upon maintaining enthusiastic interest." It is not so much a question of who has the organization. Obviously the department that has the organization takes with it the responsibility, and I have never found any lack of willingness to assume that responsibility. If such attention be given to these recommendations, as they are picked out as applying to the individual road, results will surely follow that will be gratifying to any managing officer. In fact, they are now obtaining those results. It is only a comparatively short time since they have, on a great many roads, specialized on fuel to a large extent. Service, of course, has had to be first all the time. You must be careful about what suggestions you make, because the average operating officer is going to at least give some consideration to the things you say. I just recall an engine that I rode two days ago, it was a regular engine, and it looked like a jewelry ship in the interior, and the substance of what I said to the crew when I got off was that you are doing a good job operating this engine, it is a pleasure to ride with you and I want you to tell your master mechanic or your road foreman of engines that I said so, if you want to." Incidentally I told his federal manager the first time I saw him.

Sometimes we ride engines that are not so good. I rode an engine the other day on one of the most important trains in the Eastern region, and it does the railroad no injustice to call attention to it and say that we found a condition that was not quite so good as they should have it. The next day we had a meeting and there were about fifty or sixty men there. I did not call the meeting; I was invited to it, and I said to the chief fuel supervisor, "I want to tell you that this railroad has provided a very thorough organization that has the full support of the general operating officer as well as the chief mechanical officer and every other officer on the road." I told him what the performance had been the day before when I rode the engine for forty-five minutes, and I asked what fuel they burned. They told me, and it checked very closely with my estimate.

I wanted to tell you this little story, as this was a regular engine, manned by a regular crew. We checked the work back, the mechanical officer and myself, for fifteen days at both ends of the road, and there was not a thing recorded on that engine by the engineer to show that it was wasting fuel until the night I went in, and then he said it was burning too much coal and that "the reverse gear creeps."

What the men that come here and talk on this paper want, what the chief operating officers of the railroads want is to get their money out of the things that they put on. We can get money to put all these things on the engines, but what is the use of putting all of them on if he was going to have a seventy-five per cent waste just because the man was not doing the job properly, and the man he had to supervise him was not supervising him.

J. Dickson (S. P. & S. Ry.): We have derived as much benefit from the monthly fuel meeting of each division as from any other thing that we have tried. Our fuel meeting is held on the first Tuesday or the first Monday, depending upon the division. The assistant general manager is the chairman of the fuel meeting. The superintendent of the division, the yardmaster, the chief dispatcher and all the other officers who are in charge of departments are at that meeting. We also encourage engineers, firemen, conductors, yardmen and any one we can interest in the meeting to come. We discuss the different complaints we have against each other. Instead of talking about the transportation department among ourselves, we air it at the meetings, and I have found the transportation department always ready to make improvements that help in fuel conservation. I believe that that monthly meeting is one of the best things that any railroad can institute. We have unearthed a number of things which cause fuel leaks that I don't believe we could have gotten to the bottom of otherwise.

A motion that the committee be continued and that it should broaden its investigation to cover stationary plants was carried.

Report on Specifications and Tests for Materials (A. R. M. M.)

THE COMMITTEE SUBMITS its report covering the different subjects which were reviewed during the past year and recommends that changes be made in several specifications, as shown under the respective exhibits. All references to page numbers relate to the 1916 proceedings.

Exhibit A. Specifications for Lap-welded and Seamless Steel Boiler Tubes for Locomotives

(RECOMMENDED PRACTICE, PAGE 552)

1. *Scope.*—These specifications cover lap-welded and seamless steel boiler tubes, boiler flues, superheated pipes, safe ends and arch tubes.

I. MANUFACTURE

2. *Process.*—The steel shall be made by the open-hearth process.

II. CHEMICAL PROPERTIES AND TESTS

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Carbon	0.08—0.18	per cent.
Manganese	0.30—0.60	per cent.
Phosphorus	not over 0.04	per cent.
Sulphur	not over 0.045	per cent.

4. *Check Analyses.*—(a) Analyses of two tubes in each lot of 250 or less, and of 2,000 ft. or less of safe-end material may be made by the purchaser. The chemical composition thus determined shall conform to the requirements specified in Section 3. Drillings for analyses shall be taken from several points around each tube. (b) If the analysis of only one tube does not conform to the requirements specified, analyses of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified in Section 3.

III. PHYSICAL PROPERTIES AND TESTS

5. *Flange Tests.*—(a) For all tubes 6 in. or under in diameter and having a thickness less than 9 per cent of the outside diameter, a test specimen shall have a flange turned over at right angles to the body of the tube without showing cracks or flaws. This flange, as measured from the outside diameter of the tube, shall not be less than 15 per cent of the outside diameter, but the flange shall in no case exceed ½ in. in width. (b) In making the flange test, it is recommended that the flaring tool and die block shown in Fig. 1 be used.

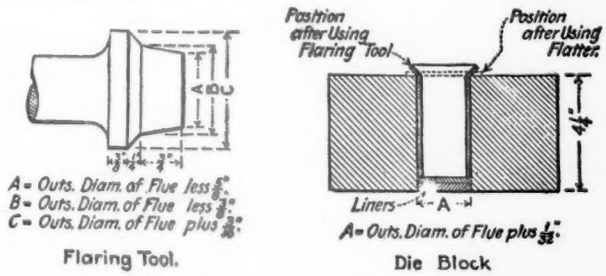

A = Outs. Diam. of Flue less 5/8"
B = Outs. Diam. of Flue less 3/4"
C = Outs. Diam. of Flue plus 3/16"
Flaring Tool.
Position after Using Flaring Tool
Position after Using Flatter
Liners
A = Outs. Diam. of Flue plus 1/32"
Die Block

Fig. 1.—Flaring Tool and Die Block for Flange Tests

6. *Flattening Test.*—(a) For all tubes, except small tubes and superheater pipes, on which the flange test is not required, a test specimen 3 in. in length shall stand flattening between parallel plates until the distance between the plates is not over three times the wall thickness, without showing cracks or flaws. For lap-welded tubes, care shall be taken that the weld is not located at the point of maximum bend. (b) For small tubes and superheater pipes on which the flange test is not required, a test specimen 3 in. in length shall stand flattening between parallel plates until the distance between the plates is not over four times the wall thickness, without showing cracks or flaws.

7. *Crush Tests.*—(a) For all tubes except superheater pipes, a test specimen 2½ in. in length shall stand crushing longitudinally until the outside folds are in contact, without showing cracks or flaws. (b) For superheater pipes, a test specimen 2½ in. in length shall stand crushing longitudinally to 1¼ in., without showing cracks or flaws.

8. *Hydrostatic Test.*—Tubes under 5 in. in diameter shall stand an internal hydrostatic pressure of 1000 lb. per sq. in., and tubes 5 in. or over in diameter shall stand an internal hydrostatic pressure of 800 lb. per sq. in.; provided that the fiber stress does not exceed 16,000 lb. per sq. in., in which case the test pressure shall be determined by the following formula:

$$P = \frac{32{,}000\ t}{D}$$

in which P = the pressure in pounds per square inch, t = the thickness of wall in inches, and D = the inside diameter of tube in inches. Lap-welded tubes shall be struck near both ends, while under the test pressure, with a 2-lb. steel hand hammer or the equivalent.

9. *Test Specimens.* (a) Test specimens shall consist of sections cut from tubes, selected by the inspector representing the purchaser, from the lot offered for shipment. They shall be smooth on the ends and free from burrs. (b) All specimens shall be tested cold.

10. *Number of Tests.*—One of each of the physical tests specified shall be made from each of two tubes in each lot of 250 or less, or each 2000 ft. or less of safe-end material. Each tube shall be subjected to the hydrostatic test.

11. *Retests.*—If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in Sections 5, 6 or 7, retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

IV. Standard Weights

12. *Standard Weights.*—The standard weights for tubes of various outside diameters and thicknesses are as indicated in Table 1.

13. *Permissible Variations.*—The weight of the tubes shall not vary more than five per cent from that specified in Table 1.

V. Workmanship and Finish

14. *Workmanship.*—(a) The finished tubes shall be circular within 0.02 in., and the mean outside diameter shall not vary more than 0.015 in. from the size ordered. (b) The thickness at any point shall not vary more than one gage above or below that specified. In the case of boiler tubes which are expanded and swaged, the thickness of the expanded end may be 1½ gages lighter, and of the swaged end two gages heavier than the thickness specified. (c) The length shall not be less, but may be 0.125 in. more than that ordered.

15. *Finish.*—The finished tubes shall be free from injurious defects and distortion, and shall have a workmanlike finish.

VI. Marking

16. *Marking.*—The name or brand of the manufacturer, the material from which it is made, and the pressure in pounds at which it was tested, shall be legibly stenciled on each tube.

VII. Inspection and Rejection

17. *Rejection.*—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 4 shall be reported within five working days from the receipt of samples. (b) Tubes when inserted in the boiler shall stand expanding and beading without showing cracks and flaws, or opening at the weld. Superheater pipes when properly manipulated shall stand all forging, welding and bending operations necessary for application without developing defects. Tubes or superheater pipes which fail in any of the above operations will be rejected and the manufacturer shall be notified.

Exhibit B. Specifications for Lap-welded Charcoal-iron Boiler Tubes for Locomotives

(Recommended Practice, Page 552)

1. *Scope.*—These specifications cover lap-welded charcoal-iron boiler tubes, boiler flues, safe ends and arch tubes for locomotives.

I. Manufacture

2. *Process.*—The tube shall be made from knobbled, hammered charcoal iron.

II. Physical Properties and Tests

3. *Bend Tests.* (a) *Quench-bend.*—Strips ½ in. in width by 6 in. in length, planed lengthwise from tubes, when heated to a cherry red and quenched at once in water the temperature of which is 80 degrees F., shall bend in opposite directions at each end, as shown in Fig. 1, without showing cracks or flaws. (b) *Nick-bend.*—Strips ½ in. in width by 6 in. in length, planed lengthwise from tubes, when nicked and broken by light blows, shall show a wholly fibrous fracture.

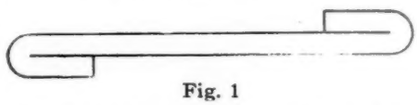


Fig. 1

4. *Expansion Test.*—A test specimen 12 in. in length shall be heated for a length of 5 in. to a bright cherry red (1200 to 1400 degrees F.), placed in a vertical position, and a smooth tapered steel pin at blue heat (600 to 800 degrees F.), forced into the end of the tube by pressure or by light blows of a 10-lb. hammer. Under this test the tube shall expand to 1⅛ times its original diameter without splitting or cracking. The pin shall be of tool steel and shall have a taper of 1½ in. per ft. of length.

TABLE 1—STANDARD WEIGHTS

Lap-welded and Seamless Steel Boiler Tubes for Locomotives
(Including Safe Ends, Arch Tubes and Large Boiler Tubes.)

Thickness, Birmingham Wire Gage.		Weight, lb. per ft. of Length. Outside Diameter, In.													
No.	In.	1¾	1⅞	2	2¼	2½	3	3½	4	4½	5	5¼	5⅜	5½	6
13	0.095	1.679	1.806	1.932	2.186	.....	.....	.....	....	.....	.....	.....	.....	.....	.....
12	0.109	1.910	2 055	2.201	2.492	2.783	3.365	.....	.....	.....	.....	.....	.....	.....	.....
11	0.120	2.089	2.249	2.409	2.729	3.050	3.691	4.331	.....	.....	.....	.....	.....	.....	.....
10	0.134	2.312	2 491	2.670	3.028	3.386	4.101	4.817	5 532	.....	.....	.....	.....	.....	.....
9	0.148	2 532	2.729	2.927	3.322	3.717	4.508	5.298	6.088	6.879	7.669	8.064	8.262	8.459	9.250
8	0.165	.....	.....	.....	.....	4.114	4.995	5.877	6.758	7.639	8.520	8.960	9.181	9.401	10.282
7	0 180	.....	.....	.....	.....	4.460	5.421	6.382	7.343	8.304	9.266	9.746	9.987	10.227	11.188

Small Superheater Pipes
(Seamless Only)

Thickness, Birmingham Wire Gage.		Weight, lb. per ft. of Length. Outside Diameter, In.										
No.	In.	5/8	11/16	¾	13/16	⅞	15/16	1	1¼	1⅜	1 7/16	1½	1⅝
13	0.095	0 537	0.601	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....
12	0.109	.....	.....	0.746	0.818	.....	.....	.....	.....	.....	.....	.....	.....
11	0.120	.....	.....	.....	.....	0.967	1.047	1 127	.....	.....	.....	.....	.....
10	0.134	.....	.....	.....	.....	.....	.....	.....	1.597	1.776	1.865	1.954	2.133
9	0.148	.....	.....	.....	.....	.....	.....	.....	1.741	1.939	2.038	2.137	2.334

5. *Crush Test.*—A test specimen 2½ in. in length shall stand crushing longitudinally to a height of 1⅛ in. without splitting in either direction and without cracking or opening at the weld.

6. *Hydrostatic Test.*—Tubes under 5 in. in diameter shall stand an internal hydrostatic pressure of 1000 lb. per sq. in., and tubes 5 in. or over in diameter shall stand an internal hydrostatic pressure of 800 lb. per sq. in., provided that the fiber stress does not exceed 16,000 lb. per sq. in., in which case the test pressure shall be determined by the following formula:

$$P = \frac{32{,}000\ t}{D}$$

in which P = the pressure in pounds per square inch, t = the thickness of wall in inches, and D = the inside diameter of the tube in inches. Lap-welded tubes shall be struck near both ends, while under the pressure, with a 2-lb. steel hand hammer, or the equivalent.

7. *Etch Test.*—In case of doubt as to the quality of material, the following test shall be made to detect the presence of steel. A cross-section of tube shall be turned or ground to a perfectly true surface, polished free from dirt or cracks, and etched until the soft parts are sufficiently dissolved for the iron tube to show a decided ridged surface, with the weld very distinct, while a steel tube would show a homogeneous surface.

8. *Test Specimens.*—(a) Test specimens shall consist of sections cut from tubes, selected by the inspector representing the purchaser, from the lot offered for shipment. They shall be smooth on the ends and free from burrs. (b) All specimens, except as specified in Section 4, shall be tested cold.

9. *Number of Tests.*—One of each of the physical tests specified shall be made from each of two tubes in each lot of 250 or less. Each tube shall be subjected to the hydrostatic test.

10. *Retests.*—If the results of the physical tests of only one tube from any lot do not conform to the requirements specified in Sections 3, 4 or 5, retests of two additional tubes from the same lot shall be made, each of which shall conform to the requirements specified.

III. Standard Weights

11. *Standard Weights.*—The standard weights for tubes of various outside diameters and thicknesses are as indicated in Table 1.

IV. Workmanship and Finish

12. *Workmanship.*—(a) Finished tubes 3½ in. or under in outside diameter shall be circular within 0.02 in. and the mean outside diameter shall not vary more than 0.015 in. from the size ordered. For tubes over 3½ in. in diameter, these variations shall not exceed 0.5 per cent of the outside diameter. (b) The thickness at any point shall not vary more than one gage above or one gage below that specified. In the case of boiler tubes which are expanded and swaged, the thickness of the expanded end may be 1½ gages lighter and of the swaged end two gages heavier than the thickness specified. (c) The length shall not be less, but may be 0.125 in. more than that ordered.

13. *Finish.*—The finished tubes shall be free from injurious defects and distortion, and shall have a workmanlike finish.

V. Marking

14. *Marking.*—The name or brand of the manufacturer, the words "knobbled charcoal," and the pressure in pounds at which it was tested, shall be legibly stenciled on each tube.

VI. Inspection and Rejection

15. *Rejection.*—Tubes when inserted in the boiler shall stand expanding and beading without splitting or breaking. Tubes which fail in this manner shall be rejected and the manufacturer shall be notified.

Exhibit C. Specifications for Air-brake Hose Gaskets

(Recommended Practice, Page 591)

(This specification is the same as that adopted by the M. C. B. Association and revised in 1918. See *Railway Age* for June 21, 1918, page 1490.)

Exhibit D. Specifications for Tank and Underframe Rivet Steel and Rivets

(Recommended Practice, Page 604)

(Same as Specifications for Rivet Steel and Rivets for Passenger and Freight Equipment Cars. See report of Committee on Specifications and Tests for Materials, M. C. B.)

Exhibit E. Specifications for Locomotive Rivet Steel and Rivets

(Recommended Practice, Page 609)

1. *Scope.*—These specifications cover steel bars for the manufacture of rivets and finished steel rivets for locomotive boilers.

I. Manufacture

2. *Process.*—The steel shall be made by the open-hearth process.

II. Chemical Properties and Tests

3. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

Manganese	0.30 to 0.50 per cent.
Phosphorus	not over 0.04 per cent.
Sulphur	not over 0.045 per cent.

4. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur. This analysis shall be made from a test ingot taken during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representative, and shall conform to the requirements specified in Section 3.

5. *Check Analyses.*—An analysis may be made by the purchaser from finished bars or rivets representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 3.

III. Physical Properties and Tests

A.—Requirements for Bars

6. *Tension Tests.*—(a) The bars shall conform to the following requirements as to tensile properties:

Tensile strength, lb. per sq. in.	45,000-55,000
Yield point, min. lb. per sq. in.	0.5 tens. str.
Elongation in 8 in. min. per cent.	$\left\{\frac{1{,}500{,}000}{\text{Tens. str.}}\right\}$ but need not exceed 30 per cent.

TABLE 1—STANDARD WEIGHTS

Lap-Welded Charcoal-Iron Boiler Tubes for Locomotives (Including Boiler Flues, Arch Tubes and Safe Ends)

Thickness Birmingham Wire Gage.		Weight, lb. per Ft. of Length. Outside Diameter, In.											
No.	In.	1¾	2	2¼	2½	3	3½	4	4½	5	5¼	5⅜	5½	6
13	0.095	1.65	1.90	2.14	2.39	....	....	....	....	....	....	....	....	....
12	0.109	1.87	2.16	2.44	2.73	3.30	....	....	....	....	....	....	....	....
11	0.120	2 05	2.36	2 68	2.99	3.62	4.25	....	....	....	....	....	....	....
10	0.134	2.27	2.62	2.97	3.32	4.02	4.72	5.42	....	....	....	....	....	....
9	0.148	2 48	2.87	3 25	3.64	4.42	5.19	5 97	6.74	7.51	7.91	8.10	8.29	9.06
8	0.165	....	....	....	4.03	4.90	5.76	6.62	7.48	8.35	8.78	9.00	9.21	10.07
7	0.180	....	....	....	4.37	5.31	6.25	7 20	8.14	9.08	9.55	9.79	10.02	10.96

(b) The yield point shall be determined by the drop of the beam of the testing machine.

7. *Bend Tests.*—(a) *Cold-bend.*—The test specimen shall bend cold through 180 deg. flat on itself without cracking on the outside of the bent portion. (b) Quench-bend.—The test specimen when heated to a light cherry red as seen in the dark (not less than 1200 degrees F.), and quenched at once in water, the temperature of which is between 80 degrees and 90 degrees F., shall bend through 180 deg. flat on itself without cracking on the outside of the bent portion.

B.—Requirements for Rivets

8. *Tension Tests.*—The rivets, when tested, shall conform to

the requirements as to tensile properties specified in Section 6 (a), except that the elongation shall be measured on a gage length not less than four times the diameter of the rivet.

9. *Bend Tests.*—(a) *Cold-bend.*—The rivet shank shall bend cold through 180 deg. flat on itself, as shown in Fig. 1, without cracking on the outside of the bent portion. (b) *Quench-bend.*—The rivet shank, when heated to a light cherry red as seen in the dark (not less than 1200 degrees F.), and quenched at once in water, the temperature of which is between 80 degrees and 90 degrees F., shall bend through 180 deg. flat on itself without cracking on the outside of the bent portion.

10. *Flattening Test.*—Rivet heads shall be flattened sideways, when cold, to a thickness of one-third and when at a driving heat to a thickness of one-fourth the original thickness of the shank, without splitting.

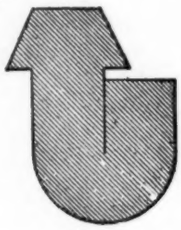


Fig. 1

11. *Test Specimens.*—(a) *Bars.*—Tension and bend test specimens shall be of the full section of bars as rolled. (b) *Rivets.*—Tension, bend and flattening test specimens shall be of the full section of rivets as manufactured. (c) When accurate account of the material has been kept and the melts can be identified, only one set of specimens for each diameter in each melt shall be taken from either the bars or the finished rivets. (d) If rivet bars or rivets have been cold-worked, the test specimens shall be heated to a drawing heat and allowed to cool in air before testing.

12. *Number of Tests.*—(a) *Bars.*—Two tension, two cold-bend and two quench-bend tests shall be made from each lot of 200 bars, or from each diameter in any one melt, each of which shall conform to the requirements specified. (b) *Rivets.*—One tension test (when specified), one cold-bend, one quench-bend and one flattening test shall be made from each lot of 50 kegs of each diameter or from each diameter in any one melt, each of which shall conform to the requirements specified. (c) If any test specimen from the bar or rivets originally selected to represent a lot of bars or rivets contains surface defects not visible before testing, but visible after testing, or if the percentage of elongation of any tension test specimen is less than that specified in Section 6 (a), and any part of the fracture is outside the middle third of the gage length, as indicated by scribe scratches marked on the specimen before testing, a retest shall be allowed.

IV. Permissible Variations in Gage

13. *Permissible Variations.*—The gage of each bar shall not vary more than 0.01 in. from that specified.

V. Workmanship and Finish

14. *Workmanship.*—The finished bars shall be circular within 0.01 in., and the rivets shall be concentric, true to form and shall be made in a workmanlike manner.

15. *Finish.*—The finished bars and rivets shall be free from injurious defects and shall have a workmanlike finish.

VI. Marking

16. *Marking.*—(a) *Bars.*—Rivet bars shall, when ready for shipment, be properly separated and marked with the name or brand of the manufacturer and the melt or lot number for identification. (b) *Rivets.*—Kegs of finished rivets shall, when ready for shipment, be properly marked with the name or brand of the manufacturer, diameter of rivets and the melt or lot number for identification. (c) *Samples.*—The melt or lot number shall be legibly stamped on each test specimen representing a lot of bars. Samples representing a lot of rivets shall be marked in a manner that will not impair their value for test purposes.

VII. Inspection and Rejection

17. *Rejection.*—(a) Unless otherwise specified, any rejection based on tests made in accordance with Section 5 shall be reported within five working days from the receipt of samples. (b) Bars or rivets which show injurious defects subsequent to their acceptance at the manufacturer's works will be rejected, and the manufacturer shall be notified.

Exhibit F. Specifications for Steel Blooms, Billets and Slabs for Carbon Steel Forgings

(Recommended Practice, Page 562)

6. That the determination of segregation, as specified in Section 8 (b), shall be omitted for "Class C" material, and the letter *C* removed from the last sentence in the paragraph.

Exhibit G. Specifications for Solid Wrought Carbon Steel Wheels

(Recommended Practice, Page 543.)

7. Sec. 8.—Add to this paragraph, following the title "Branding," the letter *a* and add as paragraph (b), the following: "(b) When so specified, the purchaser's name and serial number shall be obliterated from all rejected wheels, in the presence of the inspector."

Exhibit H. Specifications for Annealed Carbon Steel Castings for Locomotives

(Recommended Practice, Page 569.)

1. *Scope.*—These specifications cover all steel castings for locomotives and tenders, including tender truck bolsters, truck side frames, locomotive frames and driving wheel centers, as well as miscellaneous castings, classified as follows: Class A—Steel for locomotive frame. Class B.—Steel for all other castings, except as otherwise specified on individual orders.

I. Manufacture

2. *Process.*—The steel may be made by the open hearth, crucible or electric process.

3. *Heat Treatment.*—Castings shall be allowed to become cold. They shall then be uniformly reheated to the proper temperature to refine the grain and allowed to cool uniformly and slowly. If, in the opinion of the purchaser or his representative, casting is not properly annealed, he may at his option require the casting to be re-annealed.

II. Chemical Properties and Tests

4. *Chemical Composition.*—The steel shall conform to the following requirements as to chemical composition:

		Class A.	Class B.
Carbon		0.25—0.45	0 20—0.37
Manganese	not over	0.75	0.75
Phosphorus	not over	0.05	0.05
Sulphur	not over	0.05	0.05

5. *Ladle Analyses.*—An analysis of each melt of steel shall be made by the manufacturer to determine the percentage of carbon, manganese, phosphorus and sulphur. This analysis shall be made from drillings taken at least ¼ in. beneath the surface of a test ingot obtained during the pouring of the melt. The chemical composition thus determined shall be reported to the purchaser or his representatives and shall conform to the requirements specified in Section 4.

6. *Check Analyses.*—An analysis may be made by the purchaser from the broken tension test specimen or from a finished casting representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 4. Drillings for analysis shall be taken not less than ¼ in. beneath the surface of the casting.

II. Physical Properties and Tests

7. *Tension Tests.*—(a) The steel shall conform to the following minimum requirements as to tensile properties:

	Class A.	Class B.
Tensile strength, lb. per sq. in.	75,000	65,000
Elastic limit, lb. per sq. in.	0.4 Tens Str.	0.4 Tens. Str.
Yield point, lb. per sq. in.	0.45 Tens Str.	0.45 Tens. Str.
Elongation in 2 in. per cent.	1.600.000 Not under Tens. Str. 18 per cent.	1.600.000 Not under Tens. Str. 22 per cent.
Reduction of area, per cent.	30	35

(b) Either the elastic limit or the yield point, but not both, shall be determined. The elastic limit shall be determined by an extensometer and the yield point by the drop of the beam of the test machine.

(c) The yield point, or the elastic limit, shall be determined at a cross-head speed not to exceed ⅛ in. per minute, and tensile strength at a speed not to exceed 1½ in. per minute.

8. *Alternative Tests to Destruction.*—In the case of orders including only castings not exceeding 150 lb. in weight, the test to destruction of one casting from each 100 castings or smaller lot may be substituted for the tension tests. This test shall show the material to be ductile, free from injurious defects, and suitable for the purpose intended.

9. *Test Specimens.*—(a) Tension test specimens shall conform to dimensions shown in Fig. 1, the ends shall not be less than ⅞ in. in diameter and of a length and form to fit the holders of the test machine in such a manner that the load will be axial.

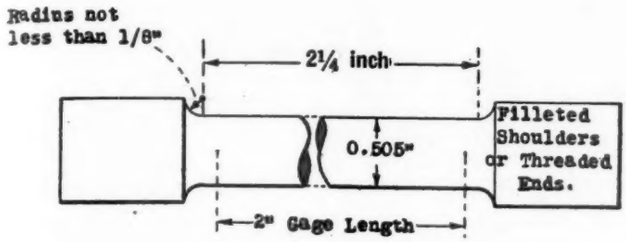


Fig. 1.—Test Specimen

(b) If the test specimen shows defective machining or develops flaws, it may be discarded and another specimen substituted.

(c) A sufficient number of test coupons, from which the required test specimen may be prepared, shall be cast attached to each end of each locomotive frame, to each locomotive cylinder, to each wheel center and to miscellaneous castings weighing over 150 lb. These test coupons shall remain attached to the castings throughout the annealing and until the castings are presented for inspection. If the design of the casting is such that the test coupons cannot be attached, they shall be cast in runners outside of the casting, but attached to it, to represent each melt. The location of the test coupons, as well as the method of casting such coupons, shall be subject to mutual agreement by the inspector and the manufacturer. In the case of any orders for casting weighing under 150 lbs., the physical properties as required in Section 7, may be determined by an extra or spare test bar cast with and attached to some other casting from the same melt.

(d) When sufficient coupons have not been cast, a test specimen may be cut from a finished casting at a location mutually agreed upon by the inspector and the manufacturer.

10. *Annealing Lugs.*—For the purpose of determining the quality of annealing at least two and not more than four annealing lugs shall be cast on all castings 150 lb. and over and on such castings less than 150 lb. as required by the purchaser. The location of the annealing lugs shall be agreed upon by the inspector and the manufacturer. The standard annealing lug shall be 1 in. in height and 1 in. in width and ⅝ in. in thickness where it joins the casting. The inspector may remove one-half and the manufacturer one-half of the number of annealing lugs.

11. *Number of Tests.*—(a) General Requirements. (1) One tensile test shall be made from each end of each locomotove frame and both tests shall meet the requirements of the specifications. One tensile test may be made from each wheel center and each locomotive cylinder casting, but at least one of each kind of such castings in each melt shall be tested. For miscellaneous castings from melts which do not include frames, wheel centers or cylinders, one tensile test shall be made from each melt. (2) If the percentage of elongation of any tension test specimen is less than that specified in Section 7 and any part of the fracture is more than ¾ in. from the center of the gage length, as indicated by scribe scratches marked on the specimen before casting, a retest shall be allowed. (3) If the results of the physical test of any test lot do not conform to the requirements specified, the manufacturer may re-anneal such lots, but not more than twice, and re-test shall be made as specified in Section 7. (4) No part of this specification shall operate to cause any one tensile test to apply to more than 40 tons of castings as offered for inspection.

(b) Special Requirements for Miscellaneous Castings.—(1) After 15 consecutive melts, which may contain any or all classes of castings (except frames, wheel centers and cylinders) covered by these specifications on one or more orders, have been tested and accepted in accordance with the above requirements, the manufacturer may group the succeeding melts in lots of five melts each; the entire group to be accepted if the test specimen selected from the lot fulfills the chemical and physical requirements herein specified. If this test fails, a rehearing will be granted on the melt that the failed bar represents, and the other four melts of the group shall be tested individually. (2) If there is a period of more than six months between shipments of the class of castings covered by these specifications, then each melt shall be tested individually until 15 consecutive melts have been accepted, after which the melts may again be grouped as in paragraph (a). (3) If one or more melts are rejected, each succeeding melt shall be tested individually until 15 consecutive melts have been accepted, after which melts may again be grouped as in paragraph (a). (4) In case of small orders for bolsters, truck sides, draft arms, yokes or castings weighing over 150 lb. where the size of the order and the available pattern and foundry equipment are such that not more than five castings can be cast in any one melt, the physical properties, as required in Section 7, will be determined from an extra or spare test coupon cast with and attached to some other casting of the same melt.

(The sections on Permissible Variations, Workmanship and Finish, Marking and Inspection and Rejection follow the wording of the corresponding sections in the M. C. B. Specifications for Annealed Carbon Steel Castings for Passenger and Freight Equipment Cars. See Report of M. C. B. Committee on Specifications and Tests for Materials.)

The report is signed by F. M. Waring (Chairman), Pennsylvania; J. C. Ramage, Southern; J. R. Onderdonk, Baltimore & Ohio; A. H. Fetters, Union Pacific; Frank Zeleny, Chicago, Burlington & Quincy; H. B. MacFarland, Atchison, Topeka & Santa Fe; Prof. L. S. Randolph, Virginia Polytechnic Institute; H. E. Smith, Chief Materials Inspector, United States Railroad Administrator.

Discussion

Mr. Waring: In addition, the committee wishes to make the addition of an Exhibit I to modify specifications for steel axles for locomotive tenders, standard page 229 of the 1917-18 proceedings. In Section 8 omit the letter A at the beginning of first paragraph. Omit the entire paragraph B. Change Section 5, check analysis, to read as follows: "An analysis shall be made by the purchaser from one axle representing each melt. The chemical composition thus determined shall conform to the requirements specified in Section 2. The drillings for this analysis shall be taken with a ⅝ in. drill from one end of the test axle at any point midway between the center and the surface." The reason for that is that the present specifications require that a 6 in. piece shall be cut off the test axle, and the most general method of drilling for check analysis is to take the drillings directly from the end of test axle. The committee saw no objection to making that substitution in the specification. *I would move that the report of the committee be accepted and go to letter ballot.*

T. L. Burton (N. Y. C.): I would like to call attention to the detail of nominal and tolerance dimensions for air-brake hose gaskets. The dimensions as here shown do not coincide throughout with the sections in recommended practice gage for hose coupling gaskets. This gage was voted a few days ago and submitted to letter ballot for advancement to standard. There seems also to have been some division of responsibilities of the committees on specifications and tests for materials and the train brake and signal committee in reference to this matter of gaskets, hose-coupling gages and so forth. In view of this the last mentioned committee submitted the matter to the General Committee to know whether the train committee was going to handle the question of dimensions for the parts mentioned, as they had done heretofore, or whether they were to be handled by the committee on specifications and tests materials. The decision was that the question of air-brake hose couplings, gaskets for air-brake hose couplings and gages for the two were to be treated as air-brake details, and all dimensions pertaining thereto were to be handled by the air-brake committee. The committee on specifications and tests of materials would deal only with the physical and chemical properties of those parts. As a result of that lack of understanding in the past you have had certain standard dimensions adopted on the recommendations of the committee on specifications for test materials for gaskets and certain dimensions for a gasket gage which

you also adopted on the recommendation of another committee, and the two did not coincide. I call this to your attention because of your having adopted conflicting recommendations in the past.

W. E. Dunham: Under the circumstances as explained by Mr. Burton, I move that the dimensions both original and limiting of the gage and of the gasket as recommended by the train-brake and signal committee be substituted in these specifications.

Mr. Burton: If you will carry out the recommendation that you adopted in connection with the train brake and signal committee's report, it will automatically do what has been suggested. The committee recommended that the matter of tolerance dimensions for the hose coupling packing rings be provided for in the gage rather than in the gasket the thought being that if you put a minimum and maximum gage, and specify that a ring should enter one side of the gage and should not enter the other, it would automatically take care of the tolerance dimensions. The committee also recommended that the specifications for the gasket include a drawing for the gage and instructions on its use. That being the case, it seems to me the matter might be cleared up by simply eliminating the tolerance dimensions in this report of the gaskets and substituting the one for the gage.

Mr. Waring: The reason these specifications do contain tolerances was that the members of the Specification Committee found that the actual gaskets that we were getting could not be checked with the gage which the Train Brake Committee had recommended. We made a thorough investigation of this gasket question, and came to the conclusion that since these tolerances were not satisfactory that it was up to us to make a set of tolerances, and that it would be desirable to have them in the specifications. That was done about a year ago. Since then I understand that the Train Brake Committee has made some changes in that gage and the tolerances. I think it would be desirable to have a joint action between these two committees, so that we could have the same understanding of the subject. In order to clear up this situation, perhaps Mr. Burton's motion to the effect that the tolerances should be removed from this specification is the one that should prevail.

The Chairman: Do you make that as an amendment, Mr. Waring? There is a motion before the convention.

Mr. Burton: I don't think the motion that was made conflicts at all with anything that was said. The motion, as I understood it, was that the gage and these dimensions be substituted for the dimensions shown in this report for the packing ring itself.

The Chairman: That is in accordance with your understanding?

Mr. Dunham: Yes, sir.

(The motion was put to a vote and carried.)

Design and Maintenance of Locomotive Boilers

UNDER DATE of February 8, 1919, the committee issued Circular *L*, containing six questions. Up to March 20 only 19 roads responded, and from their reports we derive the following general conclusions:

None of the 19 roads reports introducing any new or special designs of locomotive boilers during the last two years.

Nine roads out the 19 use electric welding in fire boxes for patches, partial side sheets, cracks and fire door patches.

Eight report no electric welding at all, and two report the use of oxy-acetylene. Only three roads report making a common practice of using electric welding as a substitute for riveted seams in the firebox and only to a limited extent in repair work. One road uses riveted seams strengthened by electric welding. In some cases seams between the crown sheet and side sheets are welded the full length without rivets, and also fire door hole flanges, without giving any further trouble. One road reports that all cross seams, and, to some extent, the fire door sheets, are either electric or acetylene welded. Mud ring corners are being successfully repaired by cutting off 18 in. each way and welding in a new corner, but the report does not specify whether this operation is done by the electric or acetylene process.

One road reports what it claims to be a successful method of reclaiming enlarged staybolt holes, by tapping out from 2 in. to 3 in. diameter and screwing in plugs the same thickness as the sheet, with both the plug and the sheet chamfered off ⅛ in. and the electric weld built up in the gutter thus formed, with a slight mound for strength. Cracks between staybolt holes are repaired by cutting out the crack to a 45 degree bevel on each side 3/16 in. apart, and building in the electric weld.

One road furnishes a sketch of a sectional flue expander with the parts which, in the standard expander, would have a bearing against the bead of the flue ground off. This is to be used on flues which are electric welded in the back sheet when they show leakage, the idea being to knock the scale off on the water side next to the sheet and prevent overheating and cracking, and at the same time avoid crowding the bead of the flue against the weld and breaking it. Grinding the expander off in this way does not impair its efficiency for roundhouse work on flues which have not been welded. Some large superheater flue expanders have been changed also, and the road claims that up to date this seems to be the most efficient tool for keeping scale away from the ferrule on the water side. This road finds it necessary to work the flues which have been welded in the sheet about every 60 days, and in bad water districts oftener. A discussion of this process of removing scale and its effect upon welded flues is invited.

One road reports electric welding smoke box studs, the inference being that the studs are butt welded to the ring to save drilling and tapping. Another road electric welds arch brick studs in a similar manner.

The most approved methods of performing the various welding operations were included in last year's report and need not be repeated here. It may also be remembered that among the roads reporting last year, 25 per cent used electric welding for entire new fire boxes, which does not agree perfectly nor conflict radically with the fact that none of the roads reporting this year mention such a practice, although one road uses oxy-acetylene welding in place of riveted seams, except in the mud ring, for all new fireboxes.

Of the 19 roads responding to Circular *L*, only 10 have had experience with combustion chambers, and all that have had them any length of time report favorably on account of improved combustion and less trouble with leaky flues. If there has been any notable change in locomotive boiler practice during the past year, it has been the re-introduction of the combustion chamber. These range all the way from the D-shaped tube sheet up to a combustion chamber reported on the new Pennsylvania Mallet as 10 ft. in length.

One member advises his view of the combustion chamber is that its main function is not so much to increase the firebox surface as it is to shorten the tubes and give increased length of flameway, to allow combustion to be more nearly completed before it is extinguished by admission to the tubes. Combustion once completed, it is immaterial whether the heat be absorbed by the firebox or by the tubes, and the more heat extracted by the firebox, the less will be the evaporation of the tubes.

The introduction of large combustion chambers naturally brings up the question of bridge walls between the combustion chamber and the firebox proper; possibly also the desirability of some form of discharge for the bank of sparks carried over the bridge. While the committee has received no data on bridge walls, we have no doubt that a discussion will develop this feature.

A member has suggested as worthy of consideration the best method of determining the water level in the extremely long boilers of to-day. This refers particularly to the long boilers on Mallet engines, which operate over heavy humps and dips.

In reply to Question 5, 11 roads have experienced trouble from cracks in boilers where the guide and waist sheet angle is fastened to the boiler shell. To overcome this, six roads have removed the rivets or studs, leaving a loose bearing. One road uses two small waist sheets instead of the one-piece design, which they find permits greater flexibility, and one road is experimenting with flexible braces between the guide yoke

and the boiler, but these have not been on the road long enough to produce results. One important road continues to rivet the angle or tee to the boiler with a ¾-in. liner inside of the boiler, which distributes the strain over a greater area with successful results. Another important road uses studs in some engines and rivets in others, but finds that the counterbalance has some effect in causing cracks at that point.

In reply to the sixth question, 13 of the 19 roads have no government engines, while the remaining six have nothing to say except one reference to the two water glasses and water column, which is believed by some to be superfluous.

Referring again to innovations in locomotive design—the attention of the committee has been directed to detail descriptions and reports of the performance of a locomotive equipped with a new type of firebox on the Chicago, Milwaukee & St. Paul, known as the "Nicholson Thermic Syphon." (See *Railway Age*, issue of January 10, 1919, page 151.) According to published test data, the engine equipped with these syphons appears to have produced some very economical results.

The report is signed by C. E. Fuller (Chairman), Union Pacific; A. W. Gibbs, Pennsylvania; D. R. MacBain, New York Central; M. K. Barnum, Baltimore & Ohio Railroad; C. B. Young, Inspection and Test Section, United States Railroad Administration, and J. Snowden Bell.

Discussion

Mr. Fuller: Since this report was made one or two members have suggested the advisability of a committee being appointed to go into the combustion chamber feature and its application.

Mr. Gaines: The combustion chamber question is one worthy of a committee. I have been making a study of that one particular feature of engine construction for a number of years. We have had little, if any, authentic data brought before the association. I have prepared, but I am not going to inflict it on the association at this time, a little data, and with your kind permission I am going to leave it with the secretary and let him include it in the proceedings.

(Mr. Gaines' paper will appear in to-morrow's *Daily*.)

Mr. Bentley: Is the welding of two-in. flues in Locomotives operating in bad water districts a good proposition? At one time we welded the flues in a large number of boilers and the flue sheets cracked and we had all sorts of trouble. Our people used to say that in good water there is no necessity for any flue welding because the flues do not leak, but in bad water you get in other complications because the flues leak and the flue sheets crack.

The Chairman: We are welding the small tubes in about 40 to 50 locomotives a month—that is about one-half of what we turn out of our shops. The only reason we don't weld more is because we haven't enough welders. We would weld them all if we had machines enough. We are rapidly getting in the machines. We have been welding flues—small flues I am talking about now—because for years we have welded all our superheaters, and we have any number of cases on record where a locomotive leaves the shop and returns after performing from 55,000 to 70,000 miles without having a boilermaker in the firebox, and if you can keep the boilermakers out of the firebox you keen down your flue troubles. I don't want to get into a discussion of how flues should be welded, but there is only one method of properly welding tubes. Tubes should be prepared the same as you did when you handled them by a boilermaker, namely, the copper gasket. The electric welding arc is the only thing that you can properly weld a small tube with and not preheat it. With the aid of the copper gasket, if any difficulty should be experienced with the flue while in service, you can go to it with your prosser expander, just the same as you could before.

Mr. Pickard (D., L. & W.): *I move you that the report be received and the committee continued, and the subject of combustion chambers be referred to the same committee.*

(*The motion was seconded and upon being put to vote was carried.*)

Report of Committee on Locomotive Headlights

H. T. Bentley
Chairman

HERETOFORE, REPORTS of the Headlight Committee have been in the nature of results obtained by tests of electric headlights and at the time they were made and conclusions reached, most railroad men, especially in thickly congested territory, and where high-powered lights had not been tried, were satisfied that such a device was a menace to the safe operation of a busy railroad and should not be used. Now that the electric headlight is with us to stay, it may be in order to refresh our memories, to give a brief history of its evolution, and after that, see what is still further needed to make the apparatus as reliable as any other part of the locomotive.

The first arc light was operated in the early eighties by an oscillating engine, which later was changed into a turbine for furnishing the power and this method, with modifications and improvements, is still in use. Objections to the arc light were many, among them being the necessity for continually changing carbons, the tremendous heat generated, the unreliability and variety in the intensity and direction of illumination and the burning out of carbon holders and other parts of the apparatus. There was no way of dimming or softening the light, and on account of its brilliancy it was very objectionable at stations or when passing trains on double track, etc. As an advertising medium and on single-track roads, particularly in the West, it was fairly successful except for failures, some of which are mentioned above.

After much experimentation it was decided in 1915 to substitute the incandescent carbon filament lamp for the arc light and a remarkable improvement in cost and operation was shown, the light being steady, uniform and more reliable. It was also possible to have a smaller lamp in the same headlight casing, so that by use of a switch it could be used when the larger lamp was objectionable at stations or on double track. On account of the lack of efficiency in the carbon lamp it was necessary to use a comparatively large generator with an accompanying high steam consumption and trouble was still experienced with the governor, and bearings had to be frequently lubricated or the machine was out of commission.

Improvements in electric lamp construction gave us the tungsten filament with its increased efficiency, so that for the same amount of current, very much greater illumination was furnished, but the frailty of this filament caused considerable trouble and failures. The lamp manufacturers later furnished a type of lamp with a short, stiff filament that was very rugged and thus the annoyance of failures from this cause was overcome. The greater efficiency of the lamps enabled a very much smaller unit, with decreased steam consumption to be used, and at about this time the lubricating devices were improved so that instead of having to oil the bearings about every eight hours they would run for several months without attention.

A dimming device was later designed, so that instead of using two lamps, one of which had to be out of focus, the 250-watt lamp in focus could be used for road work or through the medium of a resistance of 3.12 ohms could be reduced by the movement of a switch so that it was not objectionable to an engineman opposing it. The difficulty of properly focusing the lamp was taken care of by a device which enabled this to be done quickly and properly.

In the earlier recommendations of the A. R. M. M. Association committee, a 6-volt system was suggested, but on account of train-lighting systems being 32 volts, this voltage is now generally used for headlighting equipment and on

several roads, suburban coaches are lighted from the headlight equipment. To take care of this work a 2½ or 3 k. w. machine is used.

Towards the end of 1915 experiments were made with storage batteries to furnish current for the headlight. This equipment gave good results except for lamp trouble, which difficulty was later overcome, but its first cost was so high and the length of time consumed charging batteries so great, where facilities were provided for that purpose, that its use was abandoned.

The headlight reflector, silver plated, give considerable trouble with tarnishing, and a glass reflector that can be readily kept clean is very desirable. Several makers have put such reflectors on the market.

Acetylene gas was tried for headlights on a number of roads, some using a generator apparatus on the engine while others used asetylene stored in tanks. With the former practice serious accidents occurred, due to men with open torches cleaning out the spent carbide before all of the gas had been dissipated, while the storage tanks required considerable work to replace them when discharged. The light furnished was of good quality, but due to breakage of piping, clogging of burners, and the troubles mentioned above, the use of acetylene for headlight purposes was discontinued.

The amount of light necessary on a swith engine must be considered not only from the engineer's requirements but also from the switchman's stafety standpoint. Complaints are continually being made by the former that the light is not bright enough and from the latter that it is too strong, but by using a 40-watt lamp in a clean reflector, ample light is furnished to comply with the 300-ft. requirement of the law and not be objectionable to the switchmen.

There appears to be a demand in some quarters for an enclosed type of switch of more rugged construction and conveniently located within reach of the engineer, as complaints are made that the single-pole double-throw switch as generally used is not very satisfactory.

Failures frequently occur from broken steam pipes, broken field lead, excessive voltage, ground brush holders, loose connections, worn bearings and excessive valve travel, but the manufacturers and repair men are making much progress in the correction of these difficulties and we soon will have the headlight equipment as free from troubles as any properly designed machine.

Through the courtesy of the Association of Railway Electrical Engineers, the committee has been furnished with their report on this subject, and with their permission it is presented by us. We believe it gives a great deal of technical information from men well qualified to handle the subject, so that by a thorough discussion of this we will be in very much better position to know what is the best practice and be governed accordingly.

The report is signed by H. T. Bentley (Chairman), Chicago & North Western; D. F. Crawford, Locomotive Stoker Co.; C. H. Rae, Louisville & Nashville; F. A. Torrey, Chicago, Burlington & Quincy; M. K. Barnum, Baltimore & Ohio Railroad; Henry Bartlett, Boston & Maine; W. H. Flynn, Michigan Central; W. O. Moody, Illinois Central, and A. R. Ayers, New York, Chicago & St. Louis.

Exhibit A

Report of Committee on Electric Headlights A. R. E. E.

The committee, in submitting the following recommendations for standard practice for conduiting and wiring locomotive headlight equipment, has in mind the necessity of installing a conduit system that will insure good service and one that can readily be removed and applied with a minimum amount of labor, recognizing the fact that the installation is not permanent, as the engine may have to be stripped at any time to allow for repairs to the boiler, cab or other parts of the locomotive. It has, therefore, been the object of the committee to arrange the conduit plan so that the conduits could be removed with the wiring intact and placed in suitable racks ready to be reapplied to the engine when the engine repairs have been completed. Inasmuch as the installation of the conduit on the engine is usually the last thing to be done, the factor of time is an important element to be considered. The more simple the system of wiring and less complicated the conduit plan, the more readily can the men who maintain and install it do their work. The item of expense is one that enters largely in the re-application of the conduit and wiring as well as the first cost of installation, and the committee has tried to keep in mind the practicability of the installation from the maintainers' point of view.

Equipment

It is recommended that an incandescent electric headlight be adopted with a 500-watt turbo generator, c pable of developing 32 volts with full load on at a steam pressure of 125 pounds, the governor to regulate the speed of the turbine properly between steam ranges of 125 to 200 pounds.

It is recommended that manufacturers of electric headlight equipment adopt a universal standard sie of ball bearing which will be interchangeable and can be purchased on the open market. (No. 305 recommended.)

Owing to the transfer of motive power to foreign territory, the method of mounting the turbo generator should be standardized to facilitate interchanging of equipment. It is recommened that the spacing of bolt holes for mounting the turbo generators be the same on all makes of equipment, and that the thickness of the legs of the turbo generator be standard so that a standard size stud bolt can be used.

Installation of Turbo Generator—Location of Turbo Generator

The turbo generator shall be located on the top of the boiler as near the cab as practicable, with the dynamo end toward the side of the boiler equipped with the conduit system (preferably the left or fireman's side of the locomotive). Where locomotive conditions will not permit the location of the generator set at this point, it is recommended that the turbo generator be located on the left side and longitudinally with the boiler, the turbine end toward the locomotive cab and in a position not to obstruct the vision of the fireman. Under no condition should the exhaust pipe of the turbine be attached in any way to the cab. Where it is necessary to place the equipment forward of the center or at the front end of the locomotive, a ¾-in. extra heavy pipe should be run under the lagging next to the boiler for the steam supply (this to prevent steam condensation or freezing of this pipe in severe weather). It is recommended that the turbo generator be secured to the boiler with ⅞-in. stud bolts.

Piping for Steam Connections, Etc.

The steam connection shall be not less than ½-in. extra heavy pipe carried from the fountain in the cab to the turbine in such a manner that the line will drain from the throttle valve to the turbine. Where the pipe can not be drained direct to the turbine, the low point in the line should be inside the cab and a drain pipe placed with a suitable valve conveniently located so that the engineer can open and drain the steam line when the turbine is not running (this to prevent the pipe freezing). Where the steam line is brought through the cab, a clearance of at least ½ in. should be maintained around the pipe so that any movement of the cab will not break the pipe connections. Where the pipe passes through the cab, the hole shall be closed with a weather-proof cover that will allow for a free movement of the pipe.

It is recommended that two valves be used in the steam supply pipe, the one at the manifold or source of steam supply and the other to be within easy reach of the engineer. Where this valve can not be so placed, an extension handle should be used—removed from the hot steam pipe so there will be no danger of the engineer burning himself in turning the valve on or off.

Conduit and Wiring

Locomotive Wiring.—The conduit system and wiring for the electric headlight equipment on the locomotive boiler shall utilize the hand rail where possible. The wires from the turbo generator set shall run to the cab and to the front end of the locomotive in the hand-rail conduit (preferably on the left or fireman's side). This hand rail shall be of standard galvanized electric-conduit of not less than 1 in. inside diameter.

The conduit shall be supported and secured to the boiler by special hand-rail columns, provided with a detachable part

or cap to facilitate the removal of the hand-rail conduit as a unit intact. This conduit shall in no case be less than 4 in. above the engine jacket and shall have at least 2½ in. clearance over all pipes on the engine boiler. A suitable weather-proof box with a terminal block or disconnecting device should be located on the front of the cab where the wire enters, so that the wires may be readily disconnected. The connection between the hand-rail conduit and the junction box shall be a non-rigid connection (¾-in. flexible steel conduit with suitable fittings recommended). A suitable weather-proof fitting or terminal box shall be placed at the end of the hand-rail conduit with non-rigid connections between the classification lamps and the headlight case. This flexible connection shall be of sufficient length to permit the opening of the door on the front of the boiler without necessitating the removal of the headlight case. All conduits should be supported in a manner that will give at least 2 in. clearance above the boiler and in no case shall the flexible conduit rest on the smoke box. (This being unprotected with lagging, is the hottest place on the locomotive boiler.) The connection between the terminal box and the classification lamp should be so arranged that it can be easily disconnected either at the terminal box or at the lamp.

Cab Conduit.—The wiring in the cab shall preferably be installed in ½-in. rigid steel conduit so applied that it may be removed intact (approved electrical fittings to be used throughout), and where conditions permit of such location, the conduit fittings for drop cords to gage lights should be placed on the ceiling of the cab in front of and not directly over the boiler in order that they may be readily accessible. A detachable fitting should be provided for the water glass, lubricator, air and steam gage lights, to facilitate the renewal or repairs to drop cords in case of trouble; (it is advisable to fuse each of these individual drops; armored cord or flexible steel conduit has not been satisfactory and is not recommended). No. 16 or No. 18 cotton-covered lamp cord drawn through a ⅜-in. flexible asbestos tubing has proven the best for this service. Where this tubing is used the gage lamps and conduit fitting should be provided with a cover bushing or fitting having a ½-in. opening with a cupped recess, that will allow the tubing to pass through and form a knot so that the strain is taken on the tubing and not on the wire. This is formed in the tubing by turning in the ends on the cord.

Where the gage lights do not come directly under the fittings, some provision should be made to loop back and secure the drop cord so that it does not come in contact with hot steam pipes or the head of the boiler.

The conduit system in the cab should not be rigidly attached to the distributing center, neither should the conduit placed on the ceiling of the cab be rigidly connected to the conduit placed on the sides of the cab (the motion of the cab having a tendency to break the fittings or loosen the conduit). The distribution center shall consist of a single pole, double-throw switch, a common wire terminal, resistance unit and Edison plug cut-out, all mounted on the same base, and placed on the side of the cab within easy reach of the engineer. The wires from the terminal box at the front of the cab to the distribution center may be run in flexible conduit, loom, or can be taped and cleated, but in no case shall it be a fixed part of the conduit system for the cab light circuits.

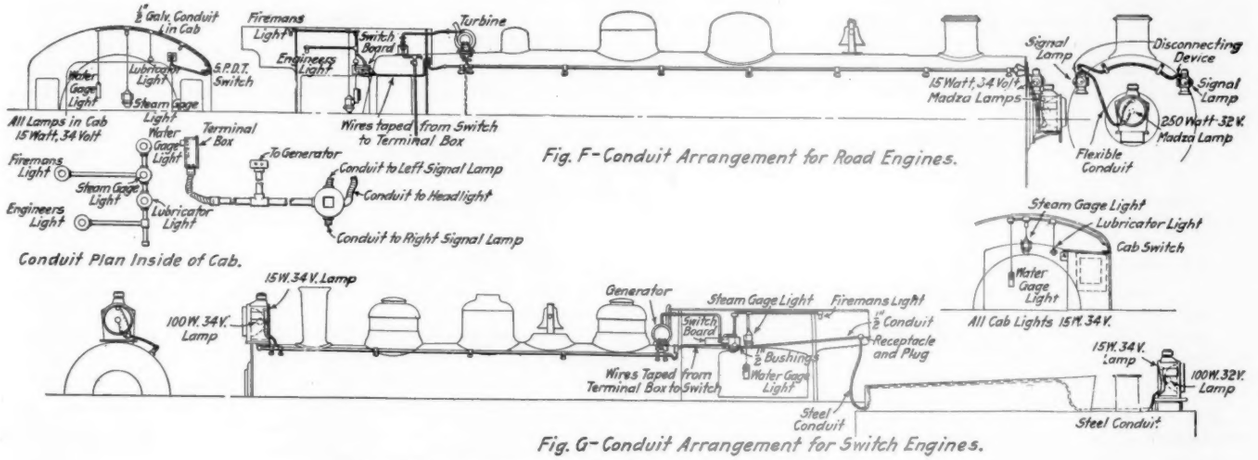
Open wiring for the cab lights (properly installed) is acceptable. See proposed conduit plans, Fig. *F*—Road Engines, Fig. *G*—Switch Engines.

Switch Board Panels

Road Engines.—The switchboard for road engines shall consist of a single-pole, double-throw switch, one resistance unit, a common wire terminal and one single branch, two-plug Edison cut-out, all mounted on the same base. The cab switch should be so connected that when the blade of the switch is in the forward position full voltage is impressed on the headlight lamp and when in the opposite position the dimming resistance is cut in the headlight circuit. (See wiring diagram Fig. *F2*.) One side of the classification and cab light circuits should be fused with 10-ampere Edison fuse plugs. Fusing of the main headlight circuit is not recommended.

Switch Engines.—The switch board for engines in switching or back-up service having front and rear headlights, shall consist of a special single-pole, double-throw switch, common wire terminal and single-branch, two-plug Edison cut-out, mounted on the same base. (A four-position switch is recommended, wired as follows): Off Position—Blade at center. First Position—Forward, front headlight full voltage. Second Position—Forward, both headlights full voltage. First Position—Reverse or back, rear headlight full voltage. Second Position—Reverse or back, both headlight full voltage.

Where desired to dim headlights, the standard resistance unit can be cut in series with the center contact at the switch blade, with a separate 10-ampere snap switch (or preferably a toggle switch) to short circuit and cut out this unit when not used. When desired to dim one or both of the headlights, this switch should be open or off and to impress full voltage on the lamps the switch should be in the normal position, which is on or closed, the headlight circuit not to be fused. (See wiring diagram, Fig. *G 2*.) The 100-watt headlamps should be placed forward of the focal position in the reflector, so as to spread and not to throw a beam of light. It is recommended that a dimming resistance which will reduce the voltage of the headlight lamp approximately one-half be used. (A standard 3.12-ohm resistance unit 8-ampere capacity be used with 250-watt, 32-volt headlight lamp to comply with the Interstate Commerce Commission ruling in this connection.) Wiring for signal lamps on engines in switching service is not recommended.



Conduit Arrangements for Road and Switch Engines

Connection Between Engine and Tender.—Where a headlight is placed on the engine tender, a detachable, approved locking type of connector with flexible steel conduit connection should be made between the engine tender and the cab. (It is recommended that this connection be made between the roof of the cab and the top of the tender, leaving slack in the flexible conduit to allow for the swing of the tender. This conduit to be carried back far enough to keep clear of the gangway. The location of the connector and conduit under the step of the cab is not recommended on account of steam and water conditions.)

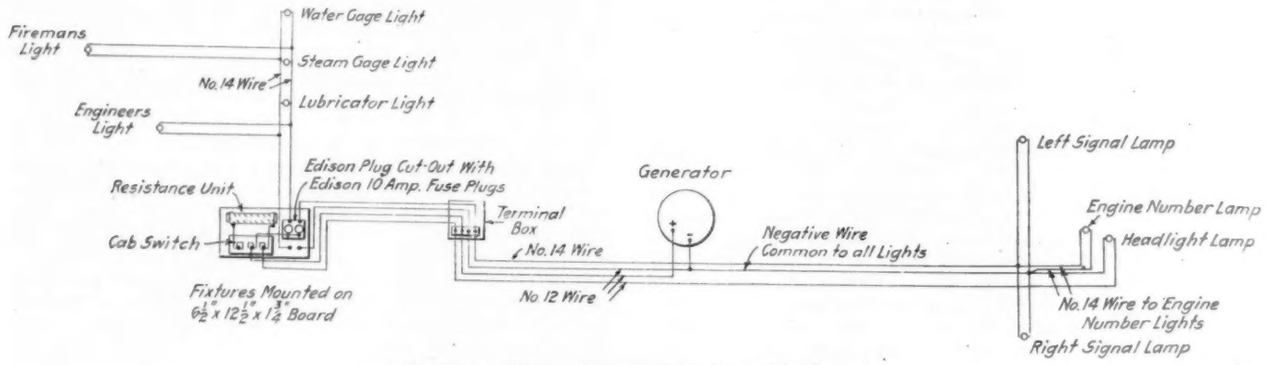


Fig. F 2.—Wiring Diagram for Road Engines

Control of Classification Lamps.—A key socket should be used in each classification lamp to require the enginemen to go to the lamp to light it, thus insuring that the lamps are burning. A switch in the cab for controlling these lamps is not recommended. The connections to the classification lamps should be made at the conduit junction box or at the lamp, which will readily permit of their removal, the connection to be weather-proof and not a part of the lamp supporting bracket.

Type of Wire

The wire from the generator to the cab switch and to the headlight lamp should be No. 12 AWG. The wire for cab lights, classification lamp or engine-number lights may be No. 14 AWG. The use of standard rubber covered and slow-burning weather-proof wire has not proven satisfactory for resisting heat, moisture, oil and mechanical strains under conditions existing in locomotive service. A wire, therefore, with insulation that will not deteriorate nor adhere to the conduit at a temperature of less than 225 degrees F., and which will not be affected by oil, water or mechanical strains, peculiar to locomotive service conditions within a period of five years, is recommended. Where stranded wire is used, lug terminals should be provided or the ends of wires soldered.

Lamps

It is recommended that a 15-watt S-17-34 volt special cab lamp be used in cabs, signal or engine number lights, and all other outlets other than the headlight lamp. It is recommended that a 250-watt G-30-32 volt concentrated filament lamp be used for headlights on road engines. It is recommended that a 100-watt G-25-32 volt concentrated filament lamp be used on switch or back-up service engines.

Discussion

Mr. Bentley: I would like to ask that the privilege of the floor be given to E. W. Jansen, electrical engineer of the Illinois Central, chairman of the headlight committee, but before we call on him I would like to make a few remarks. The report says: "The turbo generator shall be located on top of the boiler as near the cab as practicable, with the dynamo end towards the side of the boiler equipped with the conduit system (preferably the left or fireman's side of the locomotive)." We had a large number of locomotives equipped with the generator located just ahead of the cab, and during the cold weather the condensation from the exhaust pipe was so bad that it frosted the windows, and we designed an exhaust head which took care of that condensation and made it generally satisfactory. I don't see why the manufacturers could not get up a very simple exhaust head and attach it to their electric generators so that everybody could have the benefit of that device, when the generator is located just ahead of the cab. Where it is located on the smokebox, as you will notice it on some of them, I don't think the necessity for such an exhaust head is quite as apparent.

Referring to the piping for the steam connections, we have had quite a number of cases where the steampipe connections to the turbo-generator have broken off and a suggestion has been made that a flexible connection be made at that point so as to overcome that difficulty.

Under the heading of "Switch Engines," it is suggested that

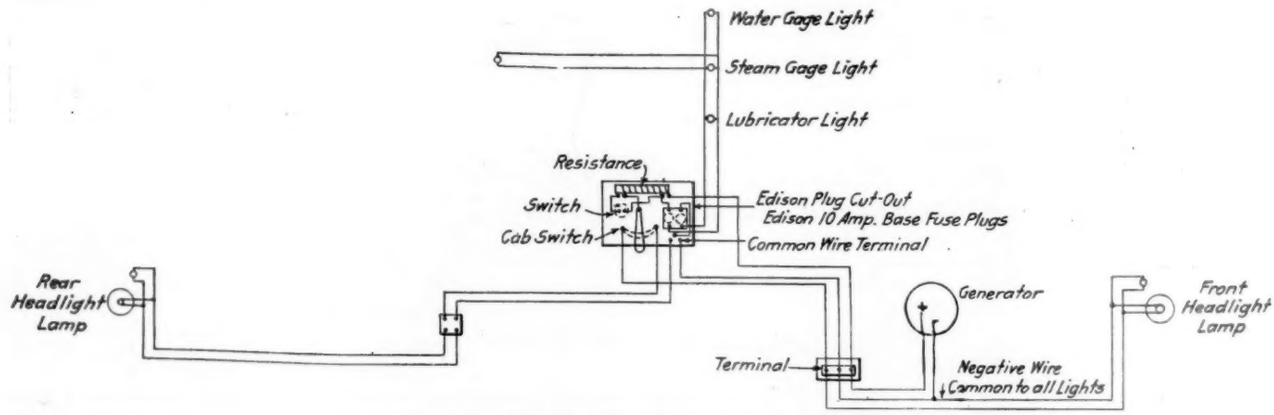


Fig. G 2.—Wiring Diagram for Switch Engines

the 100-watt headlight lamp should be placed forward of the focal position in the reflector, so as to spread and not to throw a beam of light. As I understand it, the recommendation is that instead of having a 25-watt lamp, as this committee recommends, in focus, the A. R. E. E. committee recommended a 100-watt lamp out of focus, so that instead of having a beam of light, the light is diffused, making it less objectionable for the switchman. I don't believe that we ought to use a resistance on a switch engine with the 25-watt lamp, and without a resistance there is absolutely no difficulty in complying with the requirements of the law, perfectly satisfactory to the engineer and also safe for the switchman to operate.

Under "control of classification lamps," the Electric Committee recommended that a key socket should be used in each classification lamp to require the engineman to go to the lamp to light it, thus insuring that the lamps are burning. The original installation on most railroads was to have a switch in the cab by which the blizzard lamps could be operated. The light could be turned on and off at will, but with the very large engines, the blizzard lamps being located directly in front of the smokebox, some objection has been raised that the engineer cannot tell whether his classification markers are burning or not, and therefore, for the purpose of knowing that the lights are burning, it is recommended that the key socket be used. I don't know that there is any objection to that. It is certainly very desirable to know that when you turn a switch your lamps are burning, and if you can't see it from the back of the engine, I presume the next best thing is to go up ahead and have a key socket and know that the lamp is there and burning. One case was brought to my attention where the man turned the switch on and started out, and did not have any light because somebody had taken the lamp out of his classification markers.

Discussing the question of lamps, it is stated that a 100-watt concentrated filament lamp should be used on switch or back-up service engines. I have been talking to a member of the electrical associations, and he says that "backing-up" engines means switch engines, that is, yard engines. Where an engine is in back-up service in road service, of course, a 250-watt lamp would have to be used, just the same as it would have to be used at the head end.

In closing, I want to say that the headlight lamp manufacturers and headlight manufacturers themselves are deserving of a tremendous lot of credit for the co-operation and assistance they have given the railroads in working out a hundred and one difficulties that we had to contend with.

The Chairman: You have heard the report of the committee. *A motion that it be received and opened for discussion will be in order.*

(The motion was made and carried.)

E. W. Jansen ((I. C.): In regard to the location of turbo-generators and, in fact, a good many of the recommendations of the committee, the Electrical Engineers' Association sent a questionnaire to twenty-one of the leading roads which we knew had had electric headlights in service for a great many years. A great deal of our report is from a tabulation of the majority replies of those different roads as to what they thought the best practice or the practice they were using. The installation of the turbo-generator on the left-hand side was voted by a majority of the roads as being the best place on heavy power. Where the turbo-generator is located at the front end of the engine it entails considerable steam piping and quite a loss, and located near the cab on the left-hand side it was away from the water pumps on the right-hand side. On the larger engine you cannot locate it just on top of the boiler in front of the cab for the reason that there is no space at that point, so it was located on the left-hand side, where the fireman could maintain both the steam and electric ends in case of trouble. By having the conduit on the left-hand side, on locomotives with the headlight on the smokebox, particularly with the door opening on the left-hand side, it did not necessitate cables and flexible connections going across the front of the boiler.

As regards the 100-watt lamp, that type lamp was recommended mostly on account of the government requirements specifying 250-watt lamps being used for road engines and 100 for switch engines. On some tests that were made with the 100-watt lamp it was found easy to see a man on the track on a dark night with dark clothes a distance of 300 ft., but with the 50 and 25-watt lamps you could not see anything under operating conditions as we find them, especially with the reflector all clouded up and out of condition and dirty.

We don't think the 100-watt lamp is altogether satisfactory; in fact, the average switchman complains of the 25-watt lamp, and I think the special effort of the manufacturers should be to develop reflectors that will prevent the strong light and glare of the 100-watt lamp, or the stronger sizes, and to have the rays so arranged that they will be reflected down on the step particularly. Most switchmen complain that they look at the light and then can't see the step. By having a small deflector in front of the lamp and a proper reflector you could do away with that glare and throw the light down where it is needed. But I doubt, with the 25-watt lamp, with poor headlights where the mirror is not clean and smoke in the yard, if you will be able to see anywhere near 300 ft.

As regads the wiring of cabs, there was a great deal of discussion as to whether to place the wiring in a conduit or to use open wiring, but a great many complaints are received on the last government engines. One road says that after the first six months or year they had to re-wire the cabs. But I think that is a matter of application. If the conduit is properly applied in the cab, placed where it is accessible, and the conduit leading down the side of the cab is not originally carelessly placed, and the conduit on the roof, I don't think there will be any trouble with conduit cab wiring.

The question also came up of having steel flexible covered drop cord. There are probably some makes of this cord with proper fittings that can be made up without any trouble, but the roads have tried this out and had lots of trouble. They are using ordinary lamp cord drawn through asbestos tubing, wiring the ends together. This tubing takes the strains off the connectors both on the rosette on the wall of the cab and in the socket at the lamp. We have recommended that a rosette or the fitting at the ceiling where this cord and gage light is attached to the conduit system be such that if we had to change a length, or that the cord broke or became grounded or any trouble developed, the lubricator feed lights would go out and we could just take that one cord and put in another and take the cord to the shop and repair it.

The question came up also about fusing circuits, but we did not believe in fusing the main headlight circuit, but we do know that the other lights are liable to be put out by their circuit, and for that reason we placed no fuse on the headlight circuit, because you can keep running with the use of lanterns; the main thing is to keep your headlight going and not have an engine collision.

A. G. Trumbull (Erie): There are two paragraphs of the report that have been somewhat interesting to me. One is the suggestion that the brackets for the application of the units be standardized. The application of electric headlight equipment is proceeding with considerable rapidity and in the natural order of events as prescribed by the Association's standard can only be adopted after 1921. It seems to me that this is of sufficient importance to receive consideration and be available for adoption by the railroads at an earlier date, and I suggest that that possibly might be accomplished through the medium of the General Committee.

It is also proposed, and of course, applies to the electrical association, but I observe the committee recommends that a book of instruction on the maintenance of electric headlight equipment be compiled for guidance in headlight maintenance. I have always believed that the Master Mechanics' Association or the Mechanical Section of the A. R. A., as it now is, should take the lead in adopting standard practices of maintenance. That is a very important thing, and it seems to me that the association should take such steps as are necessary to bring that formally before the convention next year in order tha twe may have a standard practice with respect to locomotive headlight equipment.

Mr. Jansen: I will say that the Association of Electrical Engineers has practically concluded a book for standard maintenance and installation. We intend to print it and give it to all our members, and we also intend to furnish the chairman of the Headlight Committee of the A. R. A. with a copy of it. It goes into the question from both the maintenance and the installation standpoint. In regard to classification lights going to the front, we felt it very important that the fireman or en-

gineer go right to the lamp and open it to know his light is burning.

On the Illinois Central we have had a key socket in these classification lamps. We use our standard classification lamp, cutting a 5/8 in. slot in the side about 1 in. deep, and make up an angle brass fitting to which we attach a 3/8 in. socket with the key up and make a groove for that and run the loop right up through that, with the proper fitting, and merely open up the top a little and drop the angle fitting in the slot. If the light should fail or the whole equipment fail, we just open the top and lift this out, let it hang and light the oil. I think that there should either be a key socket on the classification light or else a switch such as the Pennsylvania is using in the headlight, so that the man has to go to the front end and know the lights are burning. I also want to say there is a lot of room for developing of heavier fittings. The standard fittings are not heavy enough.

D. G. Redding (P. & L. E.): I would like to ask if the committee has done anything or whether it feels it is within its province, to put out rules for the operation of lights along the road. We made some observations recently and could not find there were any fixed rules that seemed to be consistent for all roads as to the dimming of lamps, methods of operating them when meeting approaching trains and similar matters.

Mr. Jansen: I think you will find the A. R. A. rules cover that very specifically. We had that up on our road and found, I believe, that you had to blanket the light. In regard to lights on switching engines, I think you will have to have a 100-watt lamp, at least, or something larger than the 25-watt lamp, to reach the 300-ft. ruling, and if you have that you almost have to have a dimmer. It doesn't cost much more, and yiu will need it in the event you should let that switch engine go out on the road. That is the reason we put that in. It is there for use in emergency if ever required.

Mr. Barnum: The chairman of the committee calls attention to the importance of going to the glass reflector. The probable reason for this is the rapid deterioration of the silvered copper reflector. The value of the new silvered reflector of the standard 18-in. dimension is somewhere around three to four times the average. The reader of the paper called attntion to the manufacturers endeavoring to manufacture an 18-in. glass reflector. I don't consider that the 18-in. reflector law is one of the Medes and Persians. I think the first thing we should do is to find out what glass reflector will comply with the law.

Tests that I have recently had the opportunity of making indicate that a 16-in. glass reflector of proper design will fulfill the requirements. The glass reflector, of course, has a constant reflecting value; it also has other values due to the refraction of glass and dispersion values, and the more shallow the lens the better headlight you get. The lens errors creep into the lighting of your right-of-way, and I would suggest that the committee's work include, during the coming year, carefully looking into the proper size of a glass reflector headlight, not only the contour and specifications for the glass, but the mounting of the glass and the best ventilation of the cage.

I think there are possibilities of doing a great deal toward ventilating a glass reflector to reduce breakage due to heat and using the high candle power lamp to a minimum. There is also a great deal that can be done in the more careful selection of metal in the construction of headlights, because we know that since we have eliminated the oil lamp from the headlight and gotten away from the use of kerosene corrosion is very rapid. I believe that on some of the loocomotives we have been reciving latly deterioration has already set in so rapidly that probably cages will have to be renewed within a year. Cast iron affords a remedy for this trouble. I believe that a cast-iron headlight can be made that will last almost indefinitely, and that the headlight can be made dust-proof to such an extent that the reflecting values will be almost constant. I would like to recommend that that be considered in the next year's action of the committee.

I would also like to call attention to the remark made in connection with classification lamps. There is a little bit to be said in connection with the engineer going out to see whether his classification lamps are burning and a little to be said against it, on the basis of safety. Perhaps the classification lamps could be so located that they would be visible from the cab and could be turned on by a snap switch and not necessitate the engineer going out front.

Mr. Woodbridge: I would liqe to suggest, too, if some of these committees have not already done so, that they recommend the most suitable location for the generator on the boiler. Placing it out on the smoke box requires an additional 30 or 40 ft. of pipe which should be insulated. I also would like to recommend that the members of this association consider very carefully the location of the gages and also the eliminating of the lighting in cabs. It is a very general practice to keep the dynamos running all the time, and that is very wasteful.

W. J. Bohan (N. P.): Mr. Chairmamn, in regard to classification lamps, it seems to me the trouble could be overcome by putting the two lamps in series with the third lamp in the cab, so that the engineer would have a warning in case the classification lamps were not burning.

E. W. Jansen (I. C.): For such a scheme, you must have two lights in series, using 15-volt lamps. This would require you to carry a special lamp, which is not advisable, as in renewing lamps you are liable to place a 15-volt lamp in some other part of the engine, causing it to burn out, or a 32-volt lamp would burn only dimly if used in the series socket.

Another thing should be considered—all road engines should have a white light at the top of the center of the tank, to be used when taking the engine through the yard. We should consider wiring the tender the same as for switch engines, put a lamp at the top of it at the back, and instead of using a ladder, making it an ordinary fixture, with a standard white lens, set with a slot to throw light down on the track on the engineer's side, so that he can know if the light is burning. We cannot get the light high enough to see over the coal pile without interfering with the water spout, or having it broken off. Only two sizes of lamps should be carried on an engine: a 25-watt lamp for main headlight and a 15-watt lamp for all other locations.

B. P. Flory (N. Y. O & W.): We are using a separate conduit for the wiring, using standard electrical fittings, and so far have had no trouble. The illustration of road engines shows the location of the headlight on the door of the smokebox, and on switch engines on the top of the smokebox. I have noticed that a number of roads have the headlight casting on top of the smokebox, some on the door, and some above the door of the smoke-box. The question has been brought up on our road that the use of a flexible conduit should be done away with, as far as possible, and it is a question whether the headlights should be located on top of the smokebox or just above the door.

H. T. Bentley (C. & N. W.): The cast-iron headlight is practically indestructible, but due to some difficulties in the foundry, we have not been successful in the manufacture of it. We hope that some manufacturer will make a cast-iron headlight which can be produced in a satisfactory manner.

In regard to Mr. Trumbull's question about the standard spacing, I think you will find that the manufacturers are getting to a common basis for a standard bolt spacing for the headlight generator, and if any man desires to apply a new headlight he will have to conform to the standards agreed upon by the manufacturers of headlihts for the standard locomotives.

W. J. Bohan (N. P.): We have used the cast iron headlight on our switching engines, and we have had no trouble in obtaining them.

H. M. Curry (N. P.): I agree with what Mr. Bentley sasy, about a fireman coming to the front end to turn on the lights, to a limited degree only. We have used electric headlights on the Northern Pacific a great many years, and to my knowledge there has been no such instance as that which he reports that has ever occurred on our line. We have used them many years. If an engineer gets an order to carry a signal, perhaps in the winter time, it is a real job for the engineer or fireman to get up on to the front end of the locomotive and turn on these lights. Our men have not been subjected to that necessity. I mention this because we are endeavoring to adopt labor saving devices. I believe that this is a necessary move, and in the right direction.

A motion that the committee be continued and enlarge the scope of the investigations which they are to carry on.

The motion was put to vote and carried.

Report of Committee on Superheater Locomotives

THE COMMITTEE SUBMITS the following report on superheated locomotives:

Superheating Existing Locomotives

The superheat schedule was somewhat delayed during the past few years, due to the shortage of labor and material caused by the war. Of the railroads reporting, practically all are going to the piston valve when superheating, either by changing to piston valve cylinders or applying a piston valve steam chest. One railroad, in superheating cross-compound locomotives, retained the slide valve on the low pressure side, using a double ported slide valve. Those reporting as retaining slide valves used bronze valves. In applying new cylinders new modern valve gears were applied to the locomotives. Considerable trouble was experienced in using the piston valve steam chest due to leaks and rapid wear. These defects have been overcome in the later designs. When superheat valve stem packing is used the life of the packing is about the same as that of a saturated locomotive.

Lubrication of Superheated Locomotives

On the railroads using slide valves no change was made in the oiling or lubricating devices when bronze valves were used, but where the original cast-iron valves were used some trouble with cutting the seats was experienced. The application of an additional system of graphite lubrication stopped the trouble.

The hydrostatic lubricator is still the standard for all locomotives and results from its use are satisfactory in most cases. A number of the railroads have taken up force feed lubrication, using a plunger type of lubricator As this practice of lubrication is very recent and data as to the performance limited, the committee does not feel justified in making any recommendation, but it is the opinion of the railroads using them that the force feed lubricator when in good condition will distribute the oil more economically, positively and regularly than the hydrostatic lubricator. It has the advantage of being outside the cab and requiring no special attention of the engineman, as the feeds are set and the lubricator stops feeding when the locomotive stops. Sufficient information is not at hand to judge as to the life of packing rings and bushings; it is the opinion of the committee that the life will be increased, but is unable to say to what extent.

Cylinder feeds are not extensively used and the committee is of the opinion that they are unnecessary and should be discontinued, as it is doubtful if any benefits are derived from their use.

The use of superheat valve oil is recommended by the majority of railroads reporting, but a large prcentage use the ordinary valve oil and claim satisfactory results. Carbonization is caused by the manner of operation.

Considerable trouble has been experienced with cylinder and valve packing. Much of this trouble has been overcome by changing the design of the rings, which, in most cases, consisted of going from a ring, with a square cross-section, to a narrow-faced ring, by using a better grade of material, and by admitting steam to the cylinders while drifting. It is the opinion of the committee that two cylinder packing rings are ample for good service.

The majority of railroads report satisfactory results from a 50 per cent lead, 50 per cent copper mixture for piston rod packing. Very good results have been obtained from 74 per cent lead, 20 per cent copper and 6 per cent nickel, and 80 per cent lead and 20 per cent antimony, especially when equipped with a hard grease piston rod lubricator, which adds greatly to the life of the softer packing. Some railroads are using tandem piston rod packing, but it is the opinion of the committee that single packing will give satisfactory results.

When automatic or manually operated drifting valves or drifting throttles are not used, instructions have been issued to enginemen to drift with what is called a cracked throttle. It is essential that steam be supplied to the cylinders while drifting. Drifting valves are not essential, but desirable, especially in a mountainous country, as the steam can be supplied by cracking the throttle. Automatic drifting valves of a good design are valuable as they eliminate the human element in furnishing steam for drifting.

A number of roads are using a manually operated drifting throtte, others are using and experimenting with automatic valves of different makes. Fifty per cent of the roads reporting do not use steam chest relief valves, and 50 per cent do when engines are not equipped with drifting valves or vacuum breakers. It is the opinion of the committee that relief valves should be used on large power if not equipped with drifting valves or vacuum breakers. It is the opinion of the committee that a properly designed drifting valve will eliminate carbon deposit, aid in lubrication, and increase the life of packing.

Maintenance

The superheater units have failed mostly at the rear return bend, the welded type giving the most trouble. The application of cast steel return bends has reduced this trouble. Some failures have occurred at the front end under the ball joint. This failure is due mainly to cinder wear, as the unit lies in the path of the cinders drawn through the tubes at a high velocity. To protest against this wear, a shield of thin steel is spot welded to the unit. Failures at this point are repaired by cutting off the worn part and welding on a new piece. No particular difference has been noted in the cinder wear of a stoker fired and hand fired locomotive. The abrasive effect of the cinders varies greatly with different coals.

The tools used to repair and maintain the units are those recommended by the Locomotive Superheater Company. When units are removed, the joints should be reground and individually tested before being replaced, and collectively after being replaced. A periodical test might be desirable, but the committee feels that it is not essential.

The majority of railroads purchase the header bolts. One uses .988 per cent carbon steel heated to between 1,400 and 1,500 degrees F. and plunged into an oil bath, then reheated and allowed to cool naturally. Another specifies that the material shall have a tensile strength of 90,000 lb. per sq. in., elastic limit not less than 65,000 per sq. in., and an elongation in 2 in. not less than 18 per cent. The metal should have the following chemical properties: carbon, .45 to .60 per cent, manganese, not over .70 per cent, sulphur not over .05 per cent, phosphorus not over .05 per cent. Some use a high grade iron without any heat treatment.

The investigation shows that in most cases a limit percentage of weight for the scrapping of superheater flues has not been established. Some give the limit percentage as from 10 per cent to 25 per cent reduction. Some give flues the hammer test. Superheater flues are reclaimed by welding up pits and holes worn in by steam leaks. It is a good practice to weld the large superheater flues to the back flue sheet. Good results have been obtained from it, and the committee recommends this practice.

All boiler tubes should be blown out each time the fire is drawn and, at least, at each washout period all tubes should be cleaned thoroughly from end to end, and all accumulations removed; special attention should be given to the superheater flues. The flues should be blown with a ¼ in. or ⅜ in. pipe and 100 lb. of air.

The method employed in testing the packing for leaks around the outside steam pipes where they enter the smoke box is by applying a lighted torch to all surface joints while the blower is on. Much trouble is experienced in keeping these joints tight. Different kinds of packings have been used with varied results. Cement and ground magnesia have been used with some success. A mixture of ground magnesia and asphaltum applied while hot gives promise of better results; this is due to the heat keeping the mixture in a semi-plastic state. The design as used on the United States standard locomotives gives promise of a high efficiency.

Most railroads have issued through bulletins or personally by the road foreman, instructions not to carry over two gages of water; this, of course, depends on the water conditions of the locality in which the locomotive is operating. The use of a pyrometer will show the men the low temperature of the steam resulting from carrying high water; it will also show the effect the position of the throttle and reverse lever has on the superheat obtained. The majority of the roads prefer a wide open

throttle with as short a cut-off as possible under the operating conditions. Some roads claim better results by using a longer cut-off and a lighter throttle, claiming better superheat.

Light, frequent and regular firing proves to be the best practice, and produces the best degree of superheat, but it is essential that at all times the flues be kept clean. The method of firing depends on the quality of fuel used.

The report is signed by W. J. Tollerton (Chairman) Chicago, Rock Island & Pacific; H. W. Coddington, Norfolk & Western; C. H. Hogan, New York Central; R. W. Bell, Illinois Central; W. C. A. Henry, Pennsylvania Lines; T. Roope, Chicago, Burlington & Quincy; E. W. Pratt, Chicago & Northwestern, and G. M. Basford.

Discussion

F. F. Gaines (U. S. R. A.): The question of whether it is advisable to apply superheaters to new engines or existing engines is no longer pertinent. The question of whether a locomotive under consideration for the application of a superheater is to be kept in service a sufficient length of time to realize a saving over the cost of installing the superheater, is one that must be given some consideration. Further, consideration should be given, in the selection of classes of locomotive to receive the superheater equipment, as to which class performs the more important service and will pay the largest return on the investment.

Considering the superheater as a standard part of the locomotive, the superheater committee would be a great service to the organization and to the railroads as a whole if it would devote its efforts to the development of standard methods of operation, maintenance and repairs. In making recommendations along these lines careful canvass should be made in a way to bring out practices in force on a majority of the railroads.

The information available indicates that the present report, which makes recommendations for the benefit of approximately 250 railroads is compiled in the returns received from thirty railroads.

To comment specifically on a few items in the report, your attention is first called to the following paragraph:

"On the railroads using slide valves a change was made in the oiling or lubricating devices when bronze valves were used, but where the original cast iron valve was used some trouble was experienced with cutting the seats and the application of an additional system of graphite lubrication stopped the trouble."

The inference to be drawn from this statements is that the operation of slide valve locomotives is a general practice and successfully accomplished without difficulty where bronze valves are used, and where cast iron valves are used the difficulty in lubricating slide valve locomotives is easily overcome by the introduction of an additional system of graphite lubrication. Out of the 35,000 locomotives operating with superheaters on the North American continent an estimate of ten would be ample to cover the number of these locomotives that are using superheated steam with slide valves. With this fact in mind, it is difficult to understand why the committee makes a statement which can be construed to recommend the use of superheated steam with slide valve locomotives. The use of superheated steam with slide valves is a dead subject in view of the facilities at hand for applying piston valves. Where benefits are to be obtained in the way of increased tractive power by increasing cylinder diameter, it is economical to apply new cylinders with piston valves, and where no advantages are to be obtained from this sourse piston valve chests are available in order to obtain piston valves which unquestionably give satisfactory results with superheated steam.

"The hydrostatic lubricator is still the standard for all locomotives and the results are satisfactory in most cases."

The above statement is rather broad, and it is to be believed that some railroads that are obtaining satisfactory results with forced feed lubricators will have difficulty in qualifying under the standard of hydrostatic lubricators for all locomotives.

"Cylinder feeds are not extensively used and your committee is of the opinion that they are unnecessary and should be discontinued, as it is doubtful if any benefits are derived from their use."

This recommendation is substantiated by the statement that out of 30 reports received, 17 report cylinder feeds as not essential, 11 as essential and 2 gave no report.

There is of course diversity of opinion as to the benefit resulting from the admission of oil to the cylinders. However, the majority just cited was so small and the percentage of the total roads represented in the report is so small that the direct recommendations that cylinder feeds be discontinued should meet with considerable objection. On the assumption that cylinder feeds are of doubtful benefit, it would seem preferable for the committee to give the safest practice the benefit of the doubt. Certainly, the admission of oil to the cylinders cannot in any way detract from better lubricating conditions, or destroy lubrication; consequently the use of cylinder feeds cannot be of negative value as far as the lubrication of the surfaces in contact is concerned, and, therefore, the uncertainty must be in favor of the cylinder feeds rather than against them. Further, there are many railroads in the country that have found the use of cylinder feeds beneficial in overcoming lubrication troubles.

"The use of superheat valve oil is recommended by the majority of railroads reporting, but a large percentage use the ordinary valve oil and claim satisfactory results from same."

This is a mere statement of facts and does not make any definite recommendation. However, the situation with reference to valve oil is similar to that which applies to the use of cylinder feed, and here, as in the case of cylinder feeds, the committee should give the favored practice the benefit of the doubt. By recommending the best that is obtainable the committee obviates the responsibility for failure. If an inferior quality of oil is used, the user assumes the responsibility and cannot use the reports of the Superheater Committee as a support for trouble that may follow the use of an inferior grade of oil.

"When units are removed the joints should be reground and individually tested before being replaced and collectively after being replaced. A periodical test might be desirable, but the committee feels that it is not essential."

If periodical tests will pay for themselves in reduction in engine failures due to leaky superheater units, they are certainly to be desired and to almost be considered essential.

"The majority of railroads purchased the header bolts. One used .998 per cent carbon steel heated to between 1400 deg. and 1500 deg. and plunged into an oil bath, then reheated and allowed to cool naturally. Another specifies that the material shall have a tensile strength of 90,000 lb. per sq. in., elastic limit not less than 65,000 lb. per sq. in. and elongation in two inches not less than 18 per cent. The metal should have the following chemical properties: Carbon .45 to .60 per cent, manganese not over 0.70 per cent, sulphur not over 0.05 per cent, phosphorus not over 0.05 per cent. Some use a high grade iron without any heat treatment."

A stronger recommendation for bolts would be that based on the elastic limits and ultimate strength rather than to attempt to cover the bolt material by a detailed chemical analysis and definite temperatures for heat treating. It is almost impossible to obtain various lots of steel which will run absolutely uniform to chemical analysis, and varying chemical analyses require different heat treatment limits in order to obtain the desired elastic limits and ultimate strength. The above recipe for heat treatment is not complete even for the chemical analysis of the material shown, inasmuch as the temperature of the reheat is not given, nor is the process of cooling after the reheat covered.

The subject of maintenance is only just touched upon in the committee's report. It might be thought by some that the information given covers the subject completely. Much benefit would be derived from a complete study and report on this subject.

There are mmany other comments which could be made in connection with the report of the Superheater Committee, but the above covers a few points which are of most importance.

Prof. L. E. Endsley (University of Pittsburgh): It is seventeen years since we started testing, at Purdue, on superheating locomotives, and there are a good many representatives of roads here today that did not have the superheater at that time.

There is one thing in this paper that I want to say a word about, and that is the pyrometer for use on superheated locomotives. I think that is the greatest forward step made by the superheater people in the last decade on superheater locomotives, and you men who have been interested in superheater locomotives, and have studied the problem, are much interested in

that subject. If the pyrometer is the success which I understand it is, it will be the greatest thing to show the efficiency of your engines that you can put on them. I have always wanted to see just such a thing—it is almost as necessary, in my opinion, as the gage on the engine itself.

I had a great deal of trouble in attempting to measure the temperature of superheated steam by thermometers, and it is a job which, even after you get it done, you do not know whether you have it right, but I believe the pyrometer is the thing to-day to be installed on the engine to give the engineman an idea of what his superheater is doing. He will get a much better efficiency out of the engine by the use of that instrument.

I am sorry to see also that some men are still adhering to a common grade of lubricating oil. We tested that matter out at Purdue, and I know, without a doubt, you will get better results if you use a better grade of oil. Those who are using the better grade of oil will not want to go back to the poorer grade, and to those who are using the poorer grade of oil I would recommend that you use the better grade of oil.

Chairman: I have been chairman of the superheater committee for a number of years. I hope ,with the elevation to my new position, I may be relieved as chairman of the Superheater committee, but I wish to say that I find this—it is a difficult matter to get information that is of interest on his one single subject. The superheater is an accomplished fact—one hundred per cent of the standard government locomotives were equipped with the superheater. Almost that percentage of new locomotives were being equipped with a superheater before the government standard was issued.

On your home roads you are equipping as many locomotives with superheaters as your facilities will permit, and there is no question that the equipment justifies the amount spent. Therefore I think it is fair to say that the superheater, as an economical feature of locomotive construction, is a fact, and it is hardly necessary for further investigation to be made as to what it has accomplished. It would like to suggest, if the committee is continued, that it go into the investigation of other economies brought about in firebox construction in the past few years. There is on the pier an exhibit of a decided improvement in firebox design, which I think is well worth investigation. I refer to the Nicholson siphon. On the railroad that the tests have been made on, the performance of it is remarkable.

H. R. Warnock (C. M. & St. P.): About one year ago we equipped the first engine with two of the Nicholson thermit siphons. This was a Consolidation engine, with 23 in by 30 in. cylinders. This class of engine was always considered overcylindered ,and for that reason it was relegated to yard work or short run work. On this test the engine was matched up against a sister engine of the same class and dimensions and put in as near the same condition as possible. The test showed an increase of boiler efficiency of 28 per cent, with an added increase of firebox heating surface of 53 sq. ft. There was 30 per cent decrease in fuel consumption per 1000 gross ton miles, with an average increase of 7 per cent in tonnage.

I might add, as a matter of information, that this test was run on a one-hundred-mile division in road service; the ruling grade was seventeen miles long and was from .5 to .7 per cent, so that it gave the crew a real test on what they could do with the new application. During this run there was no trouble in furnishing all the steam that was necessary. We thought that was quite a performance, in the absence of any figures.

The results were so gratifying that we have since equipped a Mallett with three syphons, also a Pacific type passenger engine which has a superheater, with two syphons, and later a long, narrow firebox, on a Ten-wheel engine, with one syphon. We have not the figures as yet on these latter tests, as they are being run now, but everything indicates that there will be a very good performance. The question has arisen as to the maintenance cost, and I would say that we have not had any maintenance cost in connection with those trials. There has been no indication of broken bolts in the syphon, nor have we had any trouble with leaky seams where the flanges are welded to the sheet. The water condition is not bad in this district, but there is a tendency for the formation of lime in the water. After about one year's service, the syphon is pratically as clean as when put in, indicating that the rapidity with which the water travels will take care of incrustation and things of that kind.

Mr. Redding: I would like to ask one question. This paper speaks of a satisfactory drift valve. Is there such a thing?

Mr. Gaines: In the case of engines which have slide valves, I advise you to throw the valves away, and do not equip any more engines with them, whether they have bronze or graphite lubricators.

B. H. Gray (Gulf, Mobile & Nor.): In answering the question about the drift valve, the company I represent has been using the drift valve known as the McVoy type for about two years, and they are very satisfactory. We have not had any carbozniation to speak of, and use the ordinary cylinder oil. It is such an improvement, that we have equipped all of our superheated engines with that device.

W. H. Codidngton (N. & W.): We have the McVoy valve and discarded it. It is operated by a vacuum in the cylinder, and depends on the vacuum produced in the cylinder for its operation. It is the vacuum that we want to get rid of, and we do not want to wait for the vacuum to be set up in the cylinder before the valve operates.

Mr. Curry: I presume Mr. Gaines refers to road engines, particularly.

Mr. Gaines: Yes, not the yard engines.

A. G. Trumbull (Erie): I have been considering Mr. Warnock's statement regarding the economy realized from the application of the device which he was discussing, and the figures are so startling that I would like to inquire if he has any data as to the ratios; that is, the evaporation per pound of fuel that the locomotive had under the application of this particular device. It seems to me that if it is such an important matter we ought not to let this occasion pass without geting all he informaion on it that is available.

Mr. Warnock: The entire test was published some time ago in the *Railway Age* and the *Railway Review*, and I will be glad to send Mr. Trumbull a copy of that matter. I will say, however, that there was no test made of the efficiency of the engine, before and after this particular test to which I have referred. Th engine was tested against a sister engine in the same class, put in as near the same condition as it was possible to do.

William Schlafge (Erie): Going back to Professor Endley's remarks on the subject of the pyrometer and its great value in the superheater locomotive, I may say that I am with him thoroughly on that proposition. I think it is as necessary as the steam gage on the locomotive, and you will find that the Committee on Fuel Econemy recommended that appliance very strongly in its first report. At that time the system was too delicate, but it has been improved on since, and we are getting ready to put them on our equipment.

H. T. Flanagan (C. & O.): I would like to know if the representatives of some of the other roads have made experiments with the shields to protect the necks of the superheaters because of their liability to be cut away by the sparks. We have very little trouble with leaky joints, or with any other part of the equipment, but we are having a considerable amount of trouble from the necks of heaters cutting in two, and having to be renewed on that account. I trust you will also help us to find out what system the roads are using most economically for grinding the joints of the superheaters. Are the roads using the forty-five degree angle on the header and ball joints on pipes, or have some gone to the ball joint on both? We have tried some of them, but it is more expensive to maintain, as the contour has to be exactly right.

F. P. Roesch (U. S. R. R. A): Before I became connected with the Conservation Section we had considerable experience through the cutting of the small superheater units at the neck, due to the cinder action We protected that by means of a shield, which relieved the situation materially.

We must admit that this cutting action is due to the abrasive action of the cinders passing through, and the more rapidly the cinders pass through, the greater will be the abrasive action. In pursuing some investigations, we found the conditions to be as stated in the fourth paragraph of the last page of this report: that the air leaks around the outside steam pipe entering the front ends were the most prolific cause of steam failures, and also the most prolific cause for bushing the nozzle. This, in turn, gave greater rapidity to the draft action and resulted in more cutting.

In the report of the committee it makes certain recommendations as to measures to prevent these air leaks. In traveling over the Northwest region I found that in a number of the so-called remedies the trouble is we are moving along the lines of least resistance, and trying to get something for nothing,

and we cannot get it. The putty and other dope you put in will only last for a short time. In making some dynamometer tests on the Milwaukee road, in order to determine this feature, we had the pipe packed at one end of a ninety-mile division, and the packing was entirely gone before we got to the other end of the division.

The Milwaukee, however, has developed a permanent solution. After packing the gland around the pipe they weld on 10-gage sheet iron, the outer circumference being welded to the smoke arch and the inner circumference to the steam pipe. We believe that will make a good job.

As an illustration of the effect produced through the air leaks which resulted in the friction of nozzles; after we had this pipe welded up we again opened the nozzle with a resulting decrease in fuel consumption equated on the drawbar pull of 14.2, 17.2 and up to 21 per cent., and also an increase in the efficieny of the engine line in the same ratio due to the decrease in back pressure.

Mr. Trumbull: In view of the fact that the matter of drift valves has entered the discussion, I would like to say that so far as we are concerned we believe in them, because we believe that the results of their use, in respect to improved lubrication, justify their application. If there are any members here who are sufficiently interested we will be very glad to place them in possession of information which we believe will be of interest in connection with the drift valve, and to show that it will do the work for which it is intended.

A motion that the report be received, the committee continued, and the scope of its investigation broadened to include firebox economy was put to vote and carried.

Carbonization in Valve Chambers and Cylinders of Superheated Steam Locomotives

By F. P. Roesch, Supervisor, Fuel Conservation Section, United States Railroad Administration, Northwestern Region.

WHEN I SUGGESTED the above subject to the Committee on Subjects, I thought it a good way to learn something more of a proposition in which I have always been deeply interested, and one which I felt was beyond me to solve. The committee, however, assigned the subject to me for an individual paper.

I shall refer first to the so-called carbonization or deposits of foreign matter in valve chambers, passages, etc., usually called carbonized oil. As a matter of fact this term is a misnomer, as shown by an analysis made by Dr. P. H. Conradson, Chief Chemist, Galena Signal Oil Company, (p. 169, March, 19, 1912, Proceedings o fthe Western Railway Club, and May, 1915, Proceedings of the Cincinnati Railway Club), the composition of four samples being as follows:

1st Sample.

13.35 per cent. thick oil.
2.60 per cent. oily, gummy matter.
57.15 per cent. carbonaceous combustible matter (coal and coke matter).
26.90 per cent. red ash, principally iron oxide, silicious matter.
After removing the oil and oily matter, the deposit was non-magnetic, indicating practical freedom from metallic iron.

2d Sample.

24.25 per cent. thick oil.
0.80 per cent. oily, gummy matter.
48.78 per cent. iron metal wearings.
8.18 per cent. iron oxides and silicious matter.
17.87 per cent. carbonaceous combustible matter.
After extracting the oil and oily matter, the deposit was very strongly magnetic, containing a large amount of metallic iron.

3rd Sample.

6.45 per cent. oil and oily matter.
35.70 per cent. coky, carbonaceous combustible matter.
57.28 per cent. metallic iron, iron oxides and silicious matter.
Mineral matter strongly magnetic from metallic iron wearings.

4th Sample.

4.2 per cent. oil and oily matter.
41.0 per cent. metal wearings, iron oxides, silicious matter.
54.0 per cent. coky, carbonaceous matter.
Mineral matter strongly magnetic.

From the above it will be seen that oil or oil products form but a small percentage of the whole, and the analysis also points directly to the cause, namely, smoke box gases drawn into the cylinders through the nozzle and there mixed with the oil adhering to the various ports, passages and surfaces not swept by either the valves or pistons in their movements. This combination, through the high temperatures obtaining at the moment the throttle is closed, together with practically the entire absence of steam, bakes on the surfaces above referred to almost in the form of an enamel. Again quoting Dr. Conradson: The above clearly illustrates the advisability of preventing smoke-stack gases, with their inherent dirt, dust, grit, etc., to be drawn into the cylinders while the engines are drifting. As seen from the analyses, a comparatively small amount of oil binds together a large amount of mineral matter, forming a sticky deposit which bakes on the metal much harder with superheated steam, especially high superheat, than would be the case with ordinary wet or saturated steam."

Effect on Lubrication and Maintenance

Oil is introduced into valve chambers and cylinders in order to separate the rubbing surfaces with a film of lubricant. The oils now furnished will admirably perform this function, regardless of temperature, under proper conditions, but this film of oil is infinitesimal in thickness, therefore when the throttle is closed and the locomotive so manipulated as to allow the entrance of smoke box gases, with their constituent properties of coal, coke, soot and cinders, these small particles will work their way between the pistons and cylinder walls, separating them to a degree far beyond the thickness of the oil film, so that effective lubrication, even though the quantity of oil introduced be materially increased, is practically destroyed, as the film of oil cannot fill the grooves or ridges in the rings and cylinders. Or again, this foreign matter may combine with the oil, forming an abrasive compound, causing wear of bushings, bull rings and packing rings, and thus accounting for the metallic iron, etc., found by Dr. Conradson. In fact, our investigation indicates that increasing the supply of oil beyond that required for effective lubrication simply aggravates instead of reducing the trouble.

The piston in the engine's cylinder cleans the walls of the cylinder of all the excess oil and drives out through the ports, exhaust passages and the nozzle what oil does not cling to the piston head and cylinder heads, to be carbonized at the first entrance of oxygen from the air; whereas the cylinder walls that need the lubrication for the next revolution do not have any unless the oil is injected into the steam the very next revolution.

As the lubrication is affected, so is the maintenance. Wear on valve rings and chambers, cylinder packing rings and cylinders is proportionately increased. Not only is wear through abrasion increased, but, through lack of lubrication, cylinder packing rings become overheated, resulting in their collapse, or breakage. Again, these so-called carbon deposits affect maintenance in other ways, as, for instance, cases have been observed where the deposits built up on piston and cylinder heads so as to take up practically all the clearance, in some cases knocking out cylinder heads, damaging cylinders, studs, etc., in others partially or wholly shearing rod bolts, etc.

Were the increased maintenance costs the only direct loss it might not be so serious, but, in addition to this, the deposits built up in the packing ring grooves, causing the rings to stick, producing valve and cylinder blows which materially impair the efficiency of the locomotive and result in proportionate increases in fuel and water consumption. Furthermore, cases have been observed where the exhaust passages were so constricted, due to the heavy deposits of this material, as to retard the exhaust sufficiently to greatly increase the back pressure.

A Possible Solution

In checking over the various measures adopted by different railroads to overcome the troubles mentioned above, we find a marked lack of unanimity. This is not surprising, however, when the conditions under which each operates is taken under consideration, and it is only by comparing and analyz-

ing the results obtained by the different methods that some plan can be formulated applicable to and meeting practically all conditions. Some roads block shut, or entirely remove, the steam chest relief valves, retaining the by-pass. Others block shut the by-pass and maintain the relief valve. Others again dispense with both by-pass and relief valves, while other roads maintain both. Some use a drifting throttle, some a so-called drifting valve, and others again use nothing. Some use special metal, some common grey iron, some use plain snap rings, some grooved and perforated snap rings, some segmental rings, etc. Some use a special oil, some the same as with saturated steam. Some advocate a reduction in the fatty constituents in the oil, others an increase. Some advocate the use of the hydrostatic lubricator, others favor forced feed.

Analyzing the possible effects of the various measures adopted:

The Steam Chest Relief Valve

This is a heritage handed down from the saturated steam engine. It had its place at that time and as a safety feature with certain modifications can no doubt be fittingly used on modern power. Blocking it shut or removing it entirely will certainly prevent the admission of air to the valve chamber through this source when the throttle is closed on a moving locomotive; but in this case the question arises, which is preferable in the cylinder, clean air from the outside, or smoke box gases? Inquiry seems to indicate that these valves were removed from steam locomotives, not so much to prevent carbonization, but to overcome cylinder failures which were attributed to the stresses set up by the cooling effeect of air so introduced. It may be said in passing that some years ago these valves were removed from some locomotives using saturated steam, presumably to reduce maintenance costs, and it may also be well to here remark that in this case the same deposits were in evidence on cylinder and piston heads.

By-Pass Valves

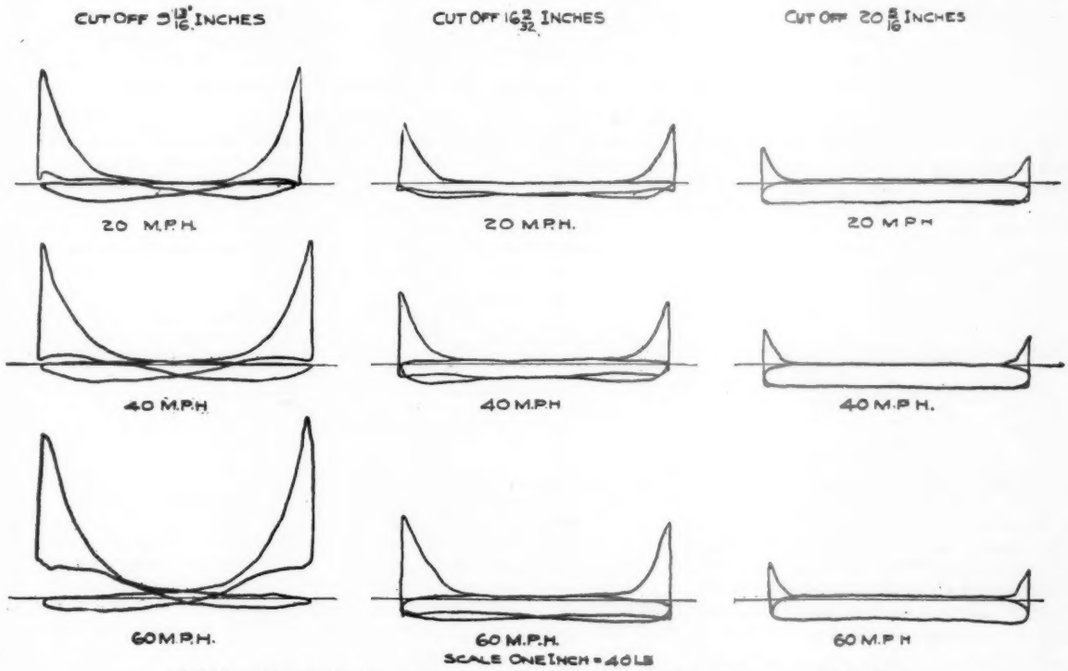
The function of this valve is to reduce the vacuum and compression created in the cylinder of the moving locomotive employing piston valves, when the locomotive is drifting, especially at high speeds. In this particular discussion we are not so much concerned with the compression as the vacuum, as the only material effect due to compression, in so far as the so-called carbonization is concerned, is to increase the temperature of the air being compressed, which, while it undoubtedly adds to the adherence of the deposit, would not, however, be otherwise serious were it not for the presence of the smoke box gases in the cylinder, which are due solely to the vacuum created. The elimination of the by-pass valve, either by blocking or removal, can have but one effect, namely, increasing the degree of vacuum, which vacuum must and will be filled from some source, either through the open relief valve, if in use, or in its absence through the nozzle, or through the admission of steam from the boiler.

The Drifting Throttle

On roads where no drifting occurs to speak of, i. e., comparatively level roads, the use of the drifting throttle, so called, will undoubtedly prevent the admission of smoke box gases to the cylinders regardless of the presence or absence of either or both steam chest relief and cylinder by-pass valves, provided, the engineer does not forget. Here, however, is the danger—human fallibility. If the engineer fails to leave his throttle slightly cracked when coming to a stop, or when tipping the summit of a grade, the damage is done even though the throttle be left closed for but a few revolutions. Each succeeding oversight adds its mite to the deposit, thus accounting for the deposits where the drifting throttle is presumably always used. As stated above, on comparatively level roads the drifting throttle can be used to advantage if men will at all times comply with instructions, but where necessary to make long drifts other means must be provided, as the drifting throttle is not always practicable, the grade, tonnage, brakes, etc., governing.

The above explains why some roads find it to their advantage to block by-pass valves, while others maintain them presumably operative. In the absence of both by-pass and relief valves much higher compression and greater vacuum will obtain than by their use, and in the case the vacuum can only be relieved through the nozzle.

In order to make this clear drifting cards are shown below. The difference in the vacuum and compression at various speeds and cut-off should be noted. These cards also indicate another factor in the proposition, namely, if it were desired to entirely overcome cylinder vacuum under such conditions it would be necessary to proportion the by-pass valves to conform to cylinder volumes. As this is mechanically impractical, however, the problem must be considered with a view to finding relief under existing conditions.



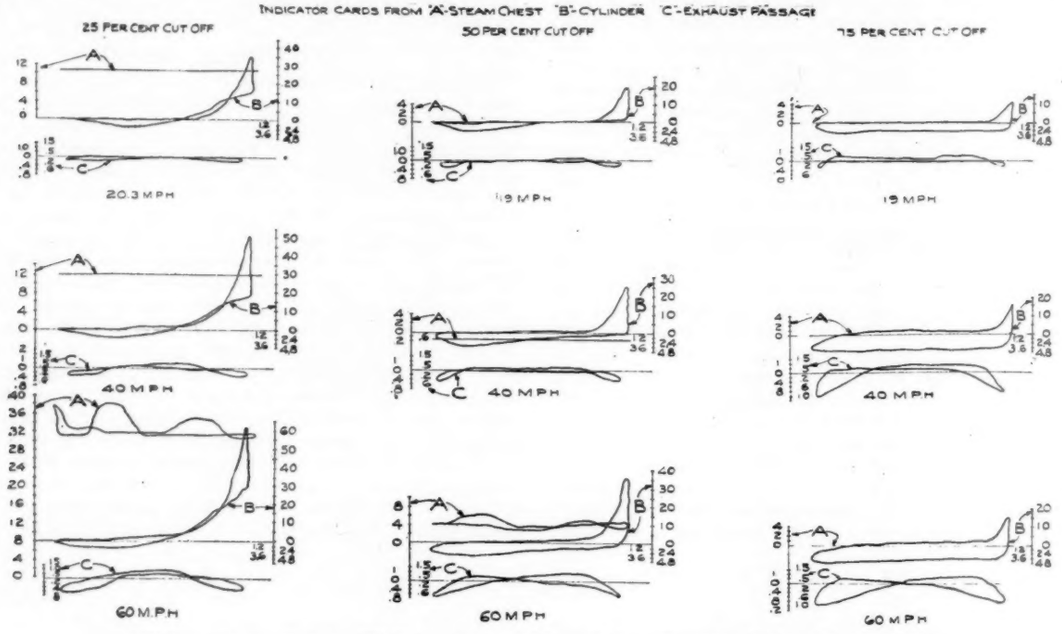
Drifting Cards Taken with No By-pass or Relief Valves on Engine

Drifting Valves

Under this head can be classed all devices used to admit steam to the steam chest and cylinders through pipes, etc., i. e., not

through the main throttle as with a drifting throttle. It is through failure to properly coordinate or take into consideration the relative movements of valve and piston that so many devices have been discarded as unsatisfactory.

The average engineer drifts his engine with the lever well hooked up, *i. e.*, in a short cut-off. Following the movements

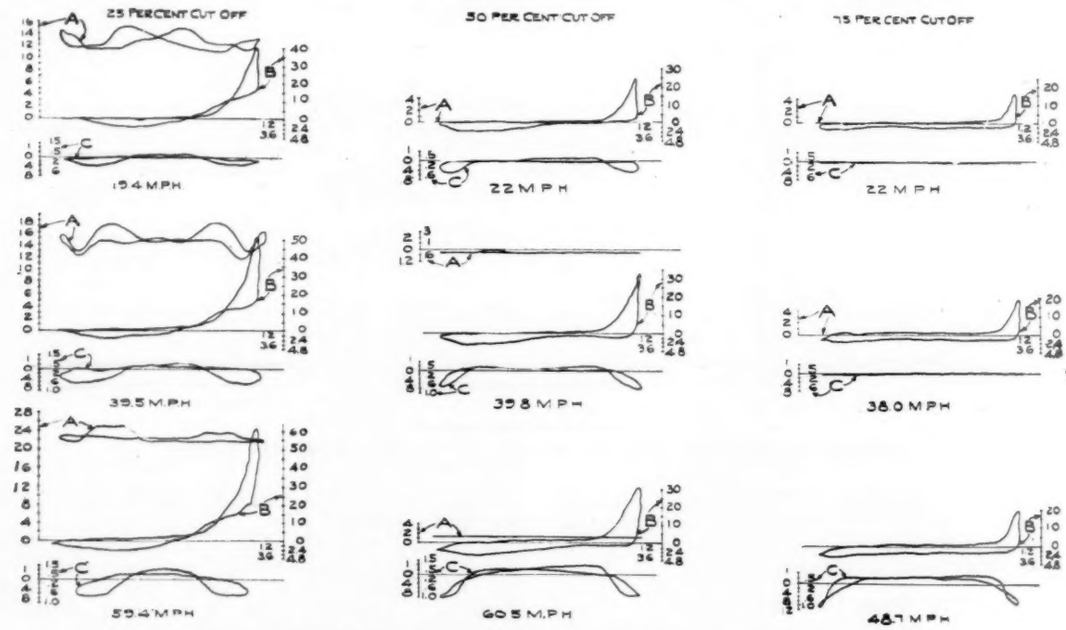

INDICATOR CARDS FROM 'A'-STEAM CHEST 'B'-CYLINDER 'C'-EXHAUST PASSAGE
25 PER CENT CUT OFF
50 PER CENT CUT OFF
75 PER CENT CUT OFF
20.3 M.P.H.
40 M.P.H.
60 M.P.H.

Drifting Cards Taken Without the Drifting Valve, By-pass Valve Blocked Shut

of the valve and piston and beginning the cycle with the initial port opening as the piston is beginning its stroke, the piston is moving back (assuming it starts from the front center), while the valve moves forward (inside admission) to complete the port opening. Continuing the cycle the valve now begins to travel back, closing the port when the piston has traveled a distance proportionate to the cut-off.

Assume that steam is being admitted to the valve chamber through a pipe of 2 in. inside diameter. The flow of steam through a 2-in. pipe at 200 lb. absolute pressure is 9 lb. per second (Napier's formula). Its volume at 40 lb. absolute pressure is 90.54 cu. ft. A locomotive with cylinders 25 in. by 30 in., drivers 63 in. in diameter, has a piston displacement equal to 8.5 cu. ft. per cylinder. Assuming this locomotive to be drifting at the rate of 30 miles per hour it would take 90.44 cu. ft. of steam per second to keep the cylinders filled at this speed; therefore, it would appear that a 2 in. pipe would more than meet the requirements under the above conditions, viz.: keep both cylinders filled with steam above atmospheric pressure.

The above would be correct did the steam ports open directly to the boiler so there would be no drop in pressure between the boiler and the cylinders, or if the intervals between port openings were so far apart as to allow the steam to bank up to boiler pressure. But as this is not the case and as the steam must decrease in pressure as the increase in volume into which it expands, and as the cylinders are continually drawing on this supply it follows, as shown by tests, that a 2-in. pipe extending from the cab to the steam chests will not maintain a pressure to



Drifting Cards Taken Without the Drifting Valve, By-pass Valve Open

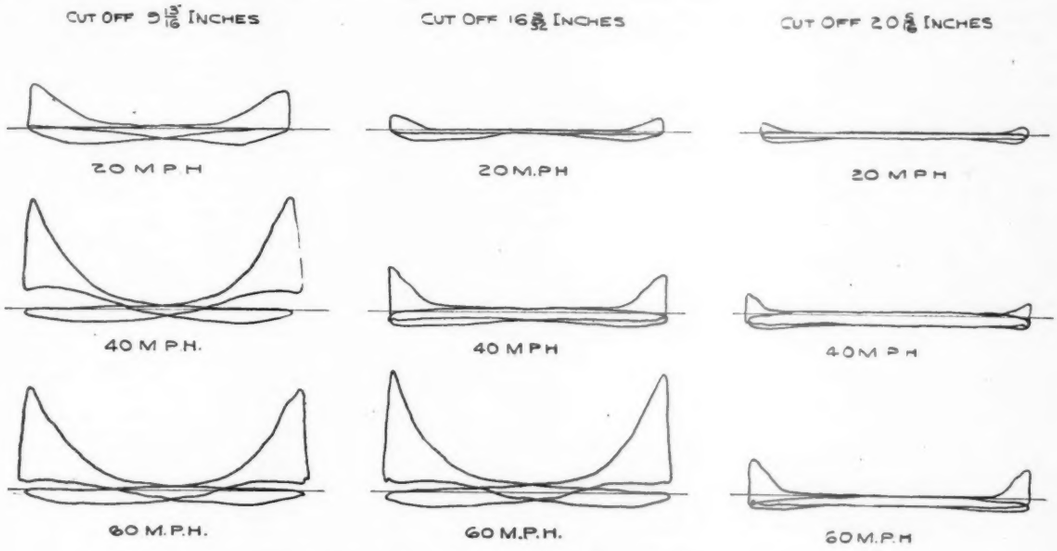
exceed 20-lb. gage or 35-lb. absolute in the valve chambers on a locomotive of the above dimensions, drifting at 30 miles per hour.

As the initial pressure in the cylinders cannot rise above the steam chest pressure, the pressure at cut-off will not exceed 35-lb. absolute; therefore, if the lever is carried at 30 per cent. stroke, the steam must again expand to three times its original volume before the piston begins its return stroke, and therefore its final pressure would not exceed 11.6 lb. providing no steam escaped at the moment the port opened to exhaust. As the pressure under such circumstances was slightly above atmospheric at the point of exhaust port opening, however, the excess pressure passed out through the nozzle until the point of equilization was reached; on the further movement of the piston the steam continued to expand with a corresponding drop in pressure to a point well below atmosphere. As no more steam is being admitted, equalization can only take place through the admission of air, and as the only opening to atmospheric pressure is by way of the nozzle, equalization will take place through this source, the inrushing air carrying with it the front end gases with all their fouling constituents. A glance at the indicator cards showing a sustained steam chest pressure of 25 lb. will clearly verify this statement.

Here, then, apparently is where and when the trouble starts. As the cylinder pressure is less than atmospheric, air will flow in through the nozzle and the open exhaust port until the pressures equalize, the combined steam, air and smoke box gases being then expelled by the piston on its return stroke. However, as the valve, valve chamber and ports are at their highest temperature and exposed to the first inrush of the incoming gases, it follows that all carbonaceous matter in these gases coming into contact with any of the above surfaces will adhere, or, in other words, be baked on. This theory appears to satisfactorily account for the greater deposits obtaining in the exhaust cavity of the valve as well as the exhaust ports and passages. Superimposing the drifting cards taken with and without by-pass and relief valves may help to clarify the proposition.

The above hypothesis, if based on correct premises, would hold good in so far as the drifting throttle is concerned, except that through use of the drifting throttle a higher initial pressure may be obtained, resulting in a correspondingly higher terminal pressure. The only truoble is, as previously stated, in the fallibility of the human agent and also the fact that the total opening of a circular valve (throttle) is very indefinite where gauged by the position of the throttle lever.

If the correctness of the above theories is established, the remedy appears obvious, namely, prevent by automatic means as far as possible the intake of smoke box gases or neutralize their evil effects by diluting with steam. To accomplish this it would appear that we should turn to such devices as we already have at hand, viz.: the steam chest relief and the by-pass valve. While the former is not exactly necessary, yet its use under proper conditions presents no great difficulty and as a safety feature it has a distinct place. The use of the by-pass, however, is practically essential in that it will go far toward preventing the formation of a vacuum in the cylinders if properly maintained, and under right treatment its maintenance cost is negligible.



Drifting Cards Taken With By-pass and Relief Valves Attached to Engine

The last and most important requirement is the neutralization of such gases as might be drawn in through the nozzle through improper handling of the locomotive. This can only be accomplished by admission of a jet of steam to both the receiving and exhaust end of the valve, so that when the conditions obtain as mentioned previously, the steam jet so admitted will mingle with the front end gases before these gases have an opportunity to deposit their constitutent matter, and so neutralize their effects, it being universally conceded that carbonization of oil, or even the deposits of the so-called carbon, will not take place in the presence of steam.

Discussion

After presenting the paper, Mr. Roesch said: Doctor Conradson made an experiment to show that with valve oil heated to 1,000 deg., when he admitted air alone, he got an explosion. When he mixed a little steam with the air nothing happened.

A motion that the paper be received and included in the minutes of the convention was but to vote and carried.

Amalgamation of Other Associati ons with Section III—Mechanical

Mr. Thompson presented the following report: Your committee on this subject was appointed too late to obtain any definite results in the short time intervening between their appointment and the convention, and, at this time, can only report progress. However, considerable preliminary work has been done, several meetings have been held with some of the different organizations and we would recommend that your committee be continued or a new committee be appointed to continue the work.

The report is signed by W. A. Thompson (chairman), New York Central; T. L. Burton, New York Central; E. W. Pratt, Chicago & North Western; J. E. Fairbanks, American Railroad

Association, and V. R. Hawthorne, American Railroad Association.

A motion that the report be received and the committee continued was carried.

Drawbar Pull-Speed-Cut-off Calibration as an Adjunct to Efficient Locomotive and Train Operation

By B. B. Milner
Engineer of Motive Power, New York Central

IT IS A FACT RECOGNIZED upon most divisions that with the same engine and the same train, some enginemen are able to handle trains over ruling grades or other difficult places to satisfactorily move trains, while others generally fail to do so. The successful men are unable to very clearly state how the successful performance is accomplished, while the unsuccessful men cannot explain any reason for failure, although they make every effort possible. A study of the factors of operation in the hands of enginemen and subject to their manipulation develops the fact that there cannot be very much in throttle manipulation. Some may run with a full throttle, some with a partially closed throttle, but the crucial test of performance upon the tight places usually occurs at speeds so low that the difference between a full throttle and partial throttle with which some men may operate, under these conditions, is nil. The only other factor which an engineman can manipulate is the selection of his cut-off, that is, the position of the reverse lever, and it should be at once appreciated that the cut-off selection or the position of the reverse lever is a very important factor because it affects directly the drawbar pull developed. It should be rather apparent that there is, for each speed, a cut-off at which the drawbar pull developed will be a maximum and that the drawbar pull developed for any other cut-off, either longer or shorter, will be less than that developed by the cut-offs which should be used under conditions, where the maximum drawbar pull is necessary.

To the end that not only the maximum drawbar pull developed at various speeds might be ascertained, but also the cut-offs—reverse lever position—which must be used at the various speeds, in order to develop this maximum drawbar pull, a series of dynamometer car tests have been run in the following fashion: The engine under test was coupled immediately ahead of the dynamometer car, then between the dynamometer car and the train, a second engine; the engine under test being run at a selected fixed cut-off, while the engine next to the train and back of the dynamometer car was used for regulating speed. A series of tests with one engine was begun by placing the reverse lever of the forward engine under test in the first notch forward, and moving the train from rest at slowly increasing speed—the second engine regulating the speed by setting of brakes or by assisting as necessary—until the speed attained was such as to cause the engine under test to fail for steam at, say 15, 18 or 20 miles per hour, dependent upon the boiler capacity. Bear in mind that during this test the reverse lever of the first engine under test was allowed to remain in the full forward notch. During this test, the dynamometer car has been writing an accurate record of the drawbar pulls developed throughout the range of speeds attained, from zero to the highest speed at which the locomotive under test failed for steam.

After this test, the train was stopped and similar test was run on the first engine, with a somewhat shorter cut-off. In this case, the drawbar pull developed at the start will be lower than at the start of the previous test, and the decrease in drawbar pull with the gradual increase in speed, will be somewhat less than in the previous case, a point being reached in speed at which the shorter cut-off will develop the same drawbar pull as the previous longer cut-off, and, then at higher speeds, the drawbar pull developed by the shorter cut-off will be the greater. This test, like the preceding one, is continued until the engine again fails for steam, which, of course, will occur at a higher speed than attained in the previous test, because of the cut-off having been somewhat shorter.

The same program of procedure is represented for succeeding shorter cut-offs, until by means of the dynamometer car, there is obtained a record of the drawbar pulls developed at all speeds from zero up to that at which the boiler failed to supply the necessary steam. By assembling the data thus obtained, we have not only a record and knowledge of the maximum drawbar pulls, which the locomotive under test will develop at any speed, but we also have a knowledge of the precise cut-off which must be used at those speeds, in order to develop the maximum drawbar pull referred to.

By means of the tests referred to above, a Mikado type engine, cylinders 25 by 32 in., driver diameter 63 in., carrying a steam pressure of 180 lb., was found to develop the greatest drawbar pull with the reverse lever in notch 1, or full cut-off, from start up to a speed of 9 miles per hour; with reverse lever notch 2, or slightly shortened cut-off, at speeds from 9 to 10½ miles per hour; in reverse lever notch 3, or slightly further shortened cut-off at speeds from 10½ to 11½ miles per hour, with reverse lever in notch 4, or with cut-off further slightly shortened, at speeds from 11½ to 13 miles per hour, etc. With a Consolidation type engine, cylinders 23 by 32 in., driver diameter 63 in., and steam pressure 200 lb., maximum drawbar pulls were found to be developed with the reverse lever in notch 1, or in the full forward position, from start to 9 miles per hour. At speeds from 9 to 11 miles per hour, the maximum drawbar pull was developed with the reverse lever in notch 2, or with slightly reduced cut-off; from 11½ to 14 miles per hour with the reverse lever in notch 3; from 14 to 15½ miles per hour with the reverse lever in notch 4, etc.

With a second Consolidation type engine with cylinders 25 by 30 in., driving wheels 57 in., and steam pressure of 180 lb., the maximum drawbar pull was found to be developed with the reverse lever in notch 1, or full forward position from start to 8 miles per hour; from 8 to 10 miles per hour with reverse lever in notch 2; from 10 to 12½ miles per hour in notch 3; from 12½ to 13 miles per hour in notch 4, etc.

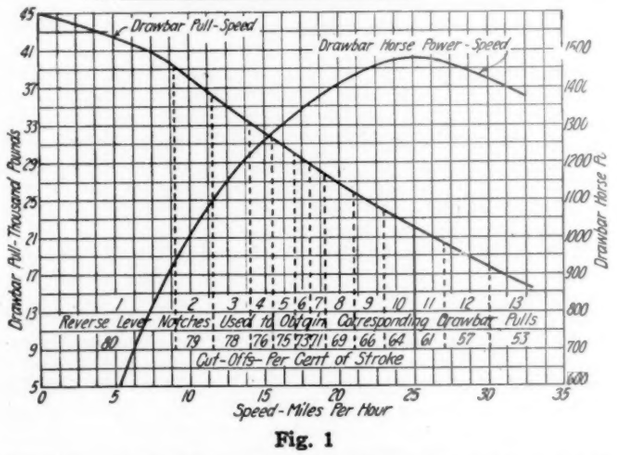


Fig. 1

It may appear at first thought that the above cut-offs are so great as to draw heavily on the capacity of the boiler for steam, but as a matter of fact, the boiler capacity, at these low speeds, namely below 15 miles per hour, should be no factor whatever in the selection of cut-off, because at such speeds, the horsepower developed by the locomotive is very much lower than that for which the boiler will supply easily the necessary steam. Maximum horsepower for average sized Mikado engines or large Consolidation engines, will be found to run from 2,000 to 2,500 h. p., these horsepowers being obtained at speeds from 22 to 28 miles per hour. For these same engines, the horsepower developed at 15 miles per hour is very much less than these referred to and the maximum for which the boilers will supply the necessary steam. These horsepowers will be further reduced

Copyrighted by B. B. Milner.

as the speed drops below 15 miles per hour, to say, 12, 10 or 8 miles per hour.

The chart herewith shown as Fig. 1 shows graphically for a Consolidation engine, the relations existing between drawbar pull and horsepower output through a range of speeds up to a little more than 30 miles per hour. It will be noted that the maximum horsepower, amounting to 1,480, was developed at a speed of 25 miles per hour from which maximum point this horsepower drops off rapidly as the speed is decreased. During the course of this fall, the margin of boiler capacity is constantly increasing.

It was found that by working locomotives at properly selected cut-offs with reverse levers in the proper positions, better time could be made up grades and between stations and that the locomotives could handle more tonnage; due, of course, to the use of the cut-offs necessary to develop the maximum drawbar pulls whenever required. On momentum grades or short heavy grades following a trackage where speed may be used in assisting trains over the grade or in any movements requiring prompt acceleration, considerable and noticeable improvement in locomotive performance can be obtained by using the cut-offs (reverse lever positions) which tests have shown to be required for maximum drawbar pull development. On long, heavy, or non-momentum grades, by working engines at the cut-offs required at the different speeds, faster moves between stations have been obtained with some increases in tonnage.

The advantages to be derived from making use of the precise cut-offs which must be used at various speeds in the development of maximum drawbar pulls, is illustrated by the accompanying chart, identified as Fig. 2, upon which is shown a graph-

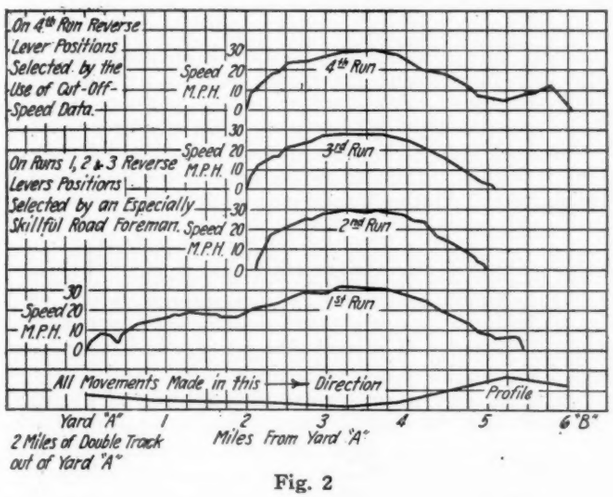

On 4th Run Reverse Lever Positions Selected by the Use of Cut-Off-Speed Data.
Speed M.P.H.
4th Run
On Runs 1, 2 & 3 Reverse Levers Positions Selected by an Especially Skillful Road Foreman.
3rd Run
2nd Run
1st Run
All Movements Made in this Direction
Profile
Yard "A"
2 Miles of Double Track out of Yard "A"
Miles From Yard "A"

Fig. 2

ical exhibit of the speeds attained with an overloaded tonnage train moving from *A* toward *B*, over a profile slightly descending for a little over 3 miles and then rising to a summit ¼ mile west of the fifth mile, this grade being the principal grade on a division and governing its tonnage by a wide margin. All of the four runs covered were made upon the same day with the same train overloaded to 15 per cent more than the regular slow freight tonnage. The first run was begun well down in the yard at "A," so that the end of double track two miles from the start, the train was going at 18 miles per hour. This speed was accelerated to a maximum of a little over 31, then decelerated over the summit, which was satisfactorily negotiated. The man was in charge of an especially skillful road foreman, selected on that account, who was instructed to take out of the engine all there was in her.

After having passed the summit the train was backed into the clear at the end of the double track from which the start for the second run was made, this being necessary in order to make the results of the tests practical since, of course, some trains must make their start from a stop at this point. The same road foreman was again in charge of the engine and did his best; however, the train stalled, as the chart shows, some distance from the summit.

After this second run, the same train was then again backed to the end of the double track for the third run. The same road foreman ran the engine on this run and was exceedingly confident of being able to negotiate the grade, having had the benefit of the experience upon the two preceding trips, but as the chart indicates, was unable to do so. After this third run, the train was again returned to the starting point at the end of the double track for the fourth run, during which the position of the reverse lever was dictated from the dynamometer car speed indicator and a chart showing the reverse lever positions necessary for the development of the maximum drawbar pulls at various speeds. It will be noted that the grade was satisfactorily negotiated at a minimum speed of 5 miles per hour.

Graphic chart (Fig. 3), shows the general relations existing between the speeds and the drawbar pulls developed by the use of the various constant cut-offs as represented by reverse lever notches, numbered 1, 2, 3, etc., consecutively from the most forward or longest cut-off reverse lever position. This chart

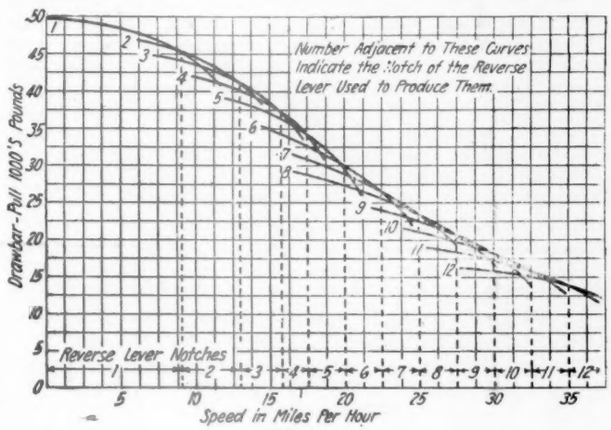

Number Adjacent to These Curves Indicate the Notch of the Reverse Lever Used to Produce Them.
Drawbar-Pull 1000's Pounds
Reverse Lever Notches
Speed in Miles Per Hour

Fig. 3

indicates that the initial drawbar pull at zero speed, or when starting, decreases with decreases in the cut-off used; that is, a longer cut-off will develop a higher initial drawbar pull, whereas a shorter cut-off will develop a correspondingly lower initial drawbar pull. This chart also indicates that at successively higher speeds, successively shorter cut-offs develop maximum drawbar pulls, or in other words, for any speed there exists a definite cut-off at which the drawbar pulls will be maximum and that during operation at this particular speed, the selection of any other than the "maximum drawbar pull cut-off" either higher or lower, will develop a lesser drawbar pull.

It becomes, therefore, apparent that some knowledge of the precise cut-offs or reverse lever positions, which, at various speeds, will result in the development of the desired maximum drawbar pull, must obtain and be used, if the maximum results, which can, and with reason, may be currently expected, are to be obtained.

For the dissemination of this information to enginemen, cards which may be folded to convenient vest pocket size, as represented upon Figs. 4 and 5, are submitted. That portion of those cards headed "Statement showing reverse lever notches and cut-offs at which maximum drawbar pulls are developed" is addressed to the question of maximum drawbar pulls and operating covered thus far, these maximum drawbar pulls and operating conditions which will produce them being of paramount importance in the determination of tonnage ratings. The determination of such ratings may be viewed in the light of being in reply to the question: "Having given a locomotive and grade and alignment conditions, what maximum tonnage can be handled?" The second questiin consistently follows, namely: "Having determined the tonnage rating, what movement may the given locomotive be expected to make therewith?" under condition which require the maximum expected performance.

To the latter question the other portion of the suggested cards referred to is addressed. For individual runs between all points thereon, the time called for under Columns A, B. C and D, thereof, providing respectively for the moving time required in passing from one point to passing the next following point; from passing one point to pulling in the clear at the next following point; from standing in the clear at one point to passing the next succeeding point, and from standing in the clear

at one point to pulling in and clearing at the next point, should be filled out by those qualified to determine the performance which may be expected under conditions which particularly require the best. It is not submitted that the "moving time" which dispatchers have a right to expect from full tonnage trains shall be at all times met, but that this "moving time" may reasonably be expected, as the situations which confront dispatchers occasionally may demand. This "moving time" information should be equitably developed and placed in the hands of dispatchers, train-masters, enginemen, conductors, road foremen, master mechanics and others who are concerned in tonnage train performance.

As indicating rather definitely the probability of finding some general need among road foremen for information bearing upon the cut-offs obtaining upon the engines in their charge for various positions of the reverse lever, and also for information as to what the position of the reverse lever should be used at various speeds in order to obtain the maximum results, the following tabular statements of such information filled in for each notch on a well established type of locomotive familiar to each of several road foremen involved, are shown. The columns of these statements headed "Cut-off Per Cent" and "Used at Speeds From—To," were filled in by 18 road foremen, very full explanations having been made to them prior to their filling in this information and during the time it was being filled in. The answers given by the first group are shown below:

First Group of Road Foremen Nos. 1 to 6.

Reverse Lever Notch.	(1) Road Foreman.			(2) Road Foreman.			(3) Road Foreman.			(4) Road Foreman.			(5) Road Foreman.			(6) Road Foreman.		
	Cut-off, %	Used at Speeds. From	To	Cut-off, %	Used at Speeds. From	To	Cut-off, %	Used at Speeds. From	To	Cut-off, %	Used at Speeds. From	To	Cut-off, %	Used at Speeds. From	To	Cut-off, %	Used at Speeds. From	To
1	95	0	4	90	0	2	97	0	2	80	0	3	80	0	3	90	0	2
2	92	4	7	85	2	4	90	2	4	70	3	4	72	3	4	85	2	4
3	90	7	9	80	4	6	88	4	6	65	4	6	64	4	5	80	4	6
4	87	9	12	78	10	12	83	6	8	60	6	10	55	5	6	75	6	8
5	85	12	15	76	14	16	78	8	12	57	10	12	46	6	7	70	8	10
6	83	15	17	68	16	22	73	12	15	55	12	14	37	7	10	65	10	12
7	80	17	25	60	22	26	68	15	20	50	14	16	30	10	12	60	12	14
8	75	25	30	55	26	30	64	20	30	45	16	20	25	12	15	55	14	16
9	72	30	40	50	30		60	30	50	40	20	25	20	15	20	50	.....	.....

From the above attention is especially called to the following abstracted therefrom:

Road Foreman.	A.	B.	C.	Road Foreman.	A.	B.	C.
1	4	95	72	10	3	90	60
2	4	90	50	11	7	100	0
3	5	97	60	12	4	80	25
4	5	80	40	13	5	80	27
5	7	80	20	14	4	93	70
6	6	90	50	15	5	93	40
7	5	100	20	16	3	80	27
8	7	85	55	17	5	93	70
9	3	80	25	18	5	97	20

A.—Reverse lever notches recommended for a period of 10 miles per hour.
B.—Cut-off said to be obtained in the first reverse lever notch.
C.—Cut-off said to be obtained in the ninth reverse lever notch.

Note that for a speed of 10 miles per hour, the judgment of these road foremen on the proper position of the reverse lever, under the conditions specified, varies from the third to the seventh notches, whereas, upon the engine in question, for this speed the first notch should be used when the development of the maximum drawbar pull is required.

This drawbar pull-speed-cut-off calibration data is needed, can be used especially with stoker fired engines advantageously, and can be obtained without a dynamometer car, as follows: An engine under test can be given a string of cars, about 25 per cent above the engine's rated capacity, on a selected section of track, the grade of which should be as nearly uniform as possible. An assisting engine should be coupled on the rear of the train for the regulation of the speed, while the engine at the head of the train should be run under constant cut-off conditions. A trial in the longest cut-off, at about two miles per hour, will locate immediately that portion of the train which the first engine will haul at that speed, this to be ascertained by observation of the slack between that portion of the train hauled by the leading engine under test and that portion of the train which is pushed by the engine which from the rear regulates the speed.

That portion of the train which the leading engine is thus found to be able to just handle can be reduced by about one car, and that portion of the train to the rear thereof cut off, leaving the engine under test at the head of the train coupled to a section thereof slightly less than it can just handle. Then, between two selected and marked points, 100 or 200 yards apart, the engine under test can be run at selected, fixed cut-offs and the difference precisely noted in the time required for the movement of the train between the two selected and marked points referred to. The differences in the drawbar pull developed by the locomotive under test, when being run at various fixed cut-offs, will be reflected immediately in the amount of time required for covering the marked distances. Any road foreman should be able to conduct such trials.

A motion that the paper be received and included in the proceedings was carried.

Railroad Mechanical Conventions in Russia*

By A. Lipetz,
Chief of the Russian
Mission of Ways of Communication.

You may be interested in knowing something about the conventions of the Russian Master Mechanics' and Master Car Builders' Associations, which we call Conventions of the Motive Power and Rolling Stock Mechanical Engineers of the Russian Railroads.

The first conventon of this kind took place, if my recollection is correct, in 1884. From that time on we held meetings almost every year. Our last convention, the twenty-ninth, took place in August, 1913, before the European war started.

I was very much pleased with the opportunity of attending the present convention because as a member of the Executive Committee of the last Russian convention, I am desirous of knowing what features of the Mechanical Section of the American Railroad Conventions it will be advisable to introduce into the Russian Association of Motive Power and Rolling Stock Mechanical Engineers.

Your association and our Russian association have much in common. While your association was busy with the standardization of details, our association from the beginning also started on standardization of rolling stock. The result is that all freight cars in Russia have been for over thirty years practically of a standard type; we had, before the war, about 500,000 of the so-called "normal" box cars of 22 tons capacity, about 80,000 "normal" flat cars, some standard gondola cars and standard tank cars, but very few cars of special design. These latter include milk cars, combined flat and rectangular tank cars, cars for special purposes belonging to private owners, which we call the "abnormal" cars. This enabled our railroads to adopt a general pooling system for car traffic where all cars are considered as general railroad property and are pooled over the entire railroad system. Every railroad is entitled to the use of as many "normal" box cars and as many "normal" flat car as it owns; if, therefore, one railroad delivers a certain number of cars to another road, the receiving road is obligated to deliver to the first road at the same point and on the same date, from midnight to midnight, an equal number of cars. The mechanical inspection and repairs take place wherever the cars happen to be at the particular time and the cost is charged to the railroad which owns the cars, at a certain schedule of rates. There can be no question of not having an axle, a wheel or another car part at any point as all cars are alike, and even cars of different types, as box cars, flat cars, gondola cars and tank cars have the same axles, wheels, couplers, buffers, brake parts, etc.

*Mr. Lipetz, at the invitation of Chairman Tollerton, made this address at the meeting of the Mechanical Section on Tuesday morning. By unanimous vote it was ordered that the address be incorporated in the association proceedings.

The locomotive standardization was taken up at the convention together with the Rolling Stock Committee, of the Railroad Administration in Petrograd, which practically means a "standardization committee." It was continuously, as the new traffic conditions required new types of engines. In 1876 there was established by law a standard railroad structure clearance diagram and a rolling stock clearance diagram, and in 1893 there was built the first standard freight locomotive—the so-called "normal" slow freight engine. In 1914, just before the war, there were 7,376 locomotives of this type, or 32.5 per cent of the total number of locomotives. In 1904 we started to design a fast freight engine and in 1914 there were 1300 or 5.7 per cent of this type. Then there were 600 slow heavy freight locomotives and in 1915 we designed and had built in the United States 1,075 Decapods, the standard fast heavy freight engine.

At almost every convention of our association a paper was presented by a committee about the results obtained from the service and performance of a standard type locomotive, usually the last, based on the data which could be obtained from different railroads.

It would be difficult for me to enumerate all the papers presented at our convention—I want to tell you only that every new question which came up, or every new device of some importance, was entrusted to a committee or to an individual for study and report. We started to investigate the superheating of steam in locomotives as early as 1898 and have made very extensive road tests with locomotives of different types with and without superheaters and the results were submitted to the convention; we have gone through very thoroughly the questions of tonnage rating, estimates of locomotive capacity and the investigation of the most economical design and operation of locomotives, etc.

But our conventions did not have the practical spirit, which I see here. Our railway supply industry is not so large and extensive as the American is, and our manufacturers never cared to exhibit their products. Therefore, we had to get acquainted with the new designs by visiting different railroads and shops. This developed the practice of changing the place of our conventions, choosing every year another place, usually one with large shops. This was also done with the purpose of giving to every road an opportunity for all their officials to attend the meetings of our conventions, as usually the long distance prevented them from attending every convention.

Comparing now our conventions with the present American Railroad Association, Section III, Mechanical Convention, I must state with pleasure that this convention is remarkable because of the extent of the knowledge which one can gather at the meetings, from papers, reports and discussions together with the practical information he receives at the exhibits. Here, in a week, he gets more than he can obtain in a year on his own road. By exchange of his practical knowledge with the other man's information he keeps himself on the level of the up-to-date mechanical science of railroading and absorbs sufficient information and inspiration to carry him over to the next convention. It is really—as Mr. W. T. Tyler said the other day—a "Post Graduate Course" for railroad men.

As a member of the Executive Committee of the Russian Conventions of Motive Power and Rolling Stock Mechanical Engineers, I want to convey to you the greetings and the best wishes of our association and to assure you that the honor which has been conferred upon me by including me into the membership of the best American Master Mechanics' Association will enable me to be more useful to my country in the expected reconstruction of our railroads.

The Enrollment Committee

EXCEPT THOSE who are intimately acquainted with the detail work over at the Enrollment Booth, few realize what a really big and oft-times thankless job it is. Registrants too often furnish inaccurate or incomplete information, such as giving the wrong hotel, room number or no hotel at all and then a correction has to be made in the official list. This one item alone runs into considerable extra work.

Again, someone sends an unknown secretary for a badge. Then it is that the committee must necessarily refuse to issue the badge, although the claimant may be of the highest character. It is obviously necessary that badges be issued to known parties and to no others, and when such a stand is taken by the committee it is only "playing the game according to the rules" and doing what is best for all interests.

Then there are the lost badges. No lost badge can be replaced, but in case of such accident, the owner is given a card which carries the privileges of the convention.

The getting out of the official list of enrollment is in itself an enterprising piece of publishing. Following the actual registration the registrant's number, name, title, business connection, hotel and room number must be transferred onto blanks prepared for the purpose in advance, they must be sorted as to classification, arranged by consecutive number and also alphabetized for cross reference. On certain days the registration is very heavy and it is necessary for the committee to buckle down to rapid detail work in order to get copy off by the last messenger to Philadelphia. The print shop works all night in order to print, bind and deliver 2,000 copies in Atlantic City by 6.30 A. M. each morning.

Added to all this work there always arise emergencies that have to be dealt with swiftly and accurately. One of those emergencies this year came because of the unexpectedly large attendance. The committee had arranged for a large number of badges, but before the end of the fourth day many of the classes of badges had been exhausted and cards had to be resorted to, which again drew on the diplomatic reserve of the committee in giving explanations.

President Walker in commenting upon the work of the Enrollment Committee says, "It has been this year an unusually trying task which the committee has handled with ability and tact and Mr. Gayetty, chairman, has voluntarily taken the responsibility and load from my shoulders in a very splendid way." The committee is certainly entitled to the gratitude of all attendants.

Baldwin Offices Abroad

WALLACE R. LEE is here from Philadelphia and reports that his company, the Baldwin Locomotive Works, will open a branch in Buenos Ayres in September under his direction. A Baldwin branch is also scheduled to open inMadrid, Spain, in July and will be in charge of H. P. Austin, a nephew of William L. Austin, until recently chairman of the board of directors of the Baldwin Locomotive Works.

Col. C. H. Crawford, recently discharged from service with the United States Government at the Eddystone munition plant will sail for Rio de Janeiro in August, where he will inaugurate the Brazilian branch for the same company.

Mr. Lee owes his appointment to the Argentina branch to his successful conduct of the West Indies office at Havana, Cuba, which under his direction grew into importance and favor.

A Topical Discussion of Air Brake Conditions

Spirited Exchange of Experiences by the East and the West; More Attention to Maintenance Needed

DURING THE SESSION of the convention held on Thursday of last week, the subject of air-brake conditions was taken up for discussion under the head of Questions Proposed by the Members. The universally unsatisfactory conditions of air-brake equipment was clearly developed during the long discussion which the subject provoked. An abstract of the discussion follows:

F. W. Brazier: I would like to call attention to the importance of the maintenance of the levers of air brakes. You would be surprised to read the Air Brake Association Proceedings in Chicago held last month. If you read Mr. Tatum's address, made before the Central Railroad Club in March and the discussion there, and see and know what you do know of the condition of air brakes on freight trains. At one time, up to February of this year we had 800 men in the car department of the New York Central doing nothing but maintaining air brakes. This included the men in the shops. That is an alarming situation, gentlemen, a payroll of $80,000 to $90,000 a month. Since the business dropped off we dropped off some of these men, but I am free to say that there is very little attention paid by some railroads to the condition of air brakes, and there is too much pnecilling of tests made—the work is not done properly. I hope when you get home that you will take up with your officials the question of having men enough to maintain this important part of the equipment, that is, the condition of the brakes. Many operating officials think that inspection is a nuisance, but you must take time to properly repair and inspect, and get the brakes in first-class condition. This is one of the things that I can impress on every man that has charge of a car department throughout this country. The work we are trying to do and the work that you ought to be doing, if you are not, is the maintaining of the air brakes on the freight equipment.

C. E. Fuller (U. P.): I endorse what Mr. Brazier said. Cars come out to the West, where we have to go over mountains, and we have to stop trains on account of the brakes being practically out of date, retaining valves will not hold the pressure, and we cannot run the trains over the mountains. They do not need the retaining valves here in the East, but any one that goes out West and sees the condition of brakes and retainers will agree that we have got to get relief from the Eastern roads. We are hauling about 75 per cent foreign cars. We need the retainers on going over the mountains and we have to delay the loads for the purpose of cleaning them.

The Chairman: I was talking to a man the other day on an Eastern road about handling trains with air brakes. Of course, they only have hills, but there are some mighty stiff grades, and he said that those Western cars were so covered up with dust that it was impossible to handle them down grades, that they did not do any work on their cars out there—they don't need to.

Mr. Fuller: I agree with you fully. We just received some cars home within the last few days that were built in 1915 and 1916. I don't think they would hold anything. They have never been repaired. They send them home for us to repair them.

D. S. Watkins (S. P.): I am glad that Mr. Fuller and Mr. Brazier have brought up this question. I tried to get this body to include the draining of reservoirs in the report on Train Brake and Signal Equipment. A test of 251 cars was conducted in Los Angeles and in the case of 21 of them they had from one-half a cupful to a gallon and a half of water in the reservoir. Ninety-five per cent of them probably were foreign cars. The retainers are never touched. I do not believe that you pople here in the East realize what the retainer is there for. You put it on the car and when you paint the car daub up the exhaust port so they are perfectly useless. If it is not too late, and if it is in order, I would like to have my motion of yesterday reconsidered.

The Chairman: Every train that goes over the Jersey Central has the retainers used at some point on the Lehigh or Susquehanna division. We are probably more interested in retainers on the Jersey Central than eight-tenths of the roads in the United States, but it is a common complaint over there about the inattention to retainers on other people's cars.

P. P. Bartholomey (Great Nor.): We have found the same trouble on our road, and I would like to ask whether or not the kind of branch tee connection used in the train pipe has been noticed. I have found quite a number of cars with just a plain union tee that permits the water, if any gets in the train line, to go straight down into the branch pipe, and after the dust collector is filled there is no other place for it to go.

Mr. Watkins: Some of the cars were equipped with a tee; some were equipped with dust collectors, and the dust collectors were filled solid so you had to take a hammer and chisel to get the dust out.

C. F. Giles (L. & N.): Every one present remembers that we received instructions from the Federal Administration some time last fall to make a record and make a monthly report of the triple valves cleaned and other attention given to cars on repair tracks, and to the air brake equipment. Every man present who has been carrying out these instructions ought to know just exactly what he is doing. It was suggested in that order that if we suceed in handling ten per cent that would take care of the air brake situation in good shape. We have exceeded that every month since that order came in. Last month we reached twelve per cent of the equipment handled on our line.

J. J. Tatum: Mr. Fuller says we have no grades in the East. We have some mountains to contend with, and inasmuch as I am somewhat acquainted with the other end of the country now, I believe we match up pretty well. If all of us did some work to get the air brakes in shape and put them in the condition the rules of this Association call for we will have good brakes, but we cannot do so by leaving the work to the other fellow.

I have some information that probably will surprise some of you. There were 175 cars tested at three different points as to air brake condition. The results were as follows:

Air Brakes—The number of cars with serviceable brakes, 135 out of 175; number of cars with non-serviceable brakes, 40 out of 175; number of cars cleaned within 12 months, 141; number of cars not cleaned within 12 months, 34; number of cars with train line leaks, 5 lb. per minute, or less, 60; number of cars, leaking more than 5 lb. per minute, 110.

Cylinder Leakage—Number of cars leaking 5 lb. per minute or less, 33; number of cars leaking more than 5 lb. per minute, 109.

Retaining Valves—Number of cars with serviceable retaining valves, 115; number of cars with non-serviceable retaining valves, 35.

Hand Brakes—Number of cars with operative hand brakes, 169; number of cars with hand brakes inoperative, 4.

Travel of Piston—Number of cars with travel of piston eight inches or less, 121; number of cars more than eight in. piston travel, 40.

The recapitulation of these figures is as follows:

Average train line leakage—5.5 lb. per min.
Average of cylinder leakage—16.5 lb. per min.
Train line test not taken on five cars on account of defects.
Cylinder tests not taken on 33 cars on account of defects.
Retaining valve test not taken on 25 cars on account of defects.
Piston travel tests not taken on 14 cars on account of defects.

That is more or less representative of the condition of the air brake equipment of this country. The air brakes were put under those cars at a very considerable cost to the railroads, and they surely should be maintained in serviceable condition, for the reason they were applied so that the locomotive engineer could properly control his train.

It is not the fault of this association that these conditions exist. The association is giving you information that will enable you to put the brakes under your cars in good condition. The difficulty is that we have not complied with the requirements of these instructions. That is no reflection on the association; it is a reflection on the individual railroad.

The fact has been stated that the Railroad Administration has suggested that the record be kept of the number of cars on which air brakes were cared for. The idea of that record is to inform the official responsible for the condition of these brakes whether or not they were taking care of a sufficient number of the equipment to maintain the air brakes in proper condition.

We find in various investigations that some of our car men say that the superintendents will not permit them to hold the trains. As a result of my investigations I believe that the car men do not always state their case fairly to the official who is responsible for these conditions, because I believe if the seriousness of the condition were made clear, the operating officer would give the car man opportunity to hold the cars and properly repair the brakes.

J. N. Milton (Rock Island): I was in Kansas a few days ago, and I find that the Western Lines are using to-day about 70 or 75 per cent of foreign equipment, and the equipment comes to our yards and our large terminals such as Chicago, Memphis or Kansas City, so rapidly that we cannot tie the cars up to give attention to the brakes in the proper manner without blocking the terminal. A railroad can handle just so much equipment, and the roads are compelled to let these cars go through as they are turned over to them in interchange.

J. J. Tatum: In regard to the blocking of terminals, I believe the existing conditions would almost bring that about, but if each railroad had performed the work it should have performed, we would not have had these conditions and our railroads would be open.

G. H. Wood (A. T. & S. F.): The members of the association have no dearth of instruction or information as to how to keep the brakes up. Mr. Tatum intimated that we had been talking about the thing too much and not doing it. That is the fact. Mr. Milton says we have not time to give the air brakes attention when the cars come to us. I do not know of a superintendent on any railroad who would tell you to run your train out without sufficient brakes, in order to control its safety. The superintendents want the trains controlled safely, and the reason we do not get the brakes fixed up is because we do not go at it and do it. I have seen hundreds of cars standing around in the yards, and standing there for days, and nobody looks at them as far as the brakes are concerned, and no provision is made that will compel them to do it. When we send the brakes out in improper condition, there is more delay on the road due to trouble with the brakes than would be required to put the brakes in proper order.

I want to appeal to the members to go at the thing along the lines we have laid down, and use the instructions and use them where you can use them. If the regional directors will check up the number of cars reported as cleaned, oiled and tested, on the railroads in their territory, they would find out that all over this country we are cleaning two or three times as many cars as there are in the country, and we are not doing a good job, simply because we do not take the time to do the job right. If the job is being done poorly, that is not the fault of the man doing the work, but our fault, because we do not insist upon its being done properly. At some points where brake work is done there is nobody directly in charge of the work. The only way to keep them in the best possible condition is to put them in that condition when we first clean them, and we will find by doing this that we will get much more satisfactory results.

Cast Steel Chain

The beginning of the world war found chain makers quite as unprepared as all other industries. The Government called for production of anchor chain and the answer from makers of forged chain indicated that the required amount could not be produced. Chain makers cannot learn their trade in a day. Then the new idea insisted on recognition. Chain had never been cast, but necessity met the emergency. Cast steel molders produced a chain stronger than the forged chain, cast in any desired length and in any size. Perhaps no more significant instance can be found of the far-reaching influence of the war. Forged iron chain, that for so long had held supremacy, almost in a day finds a rival which may be its master.

Conventionalities

"Big Dan" Cunningham's daughter, Miss Margaret, arrived here with her mother and sister, Dorothy, Sunday evening from Salt Lake City, and will remain until the end of the convention.

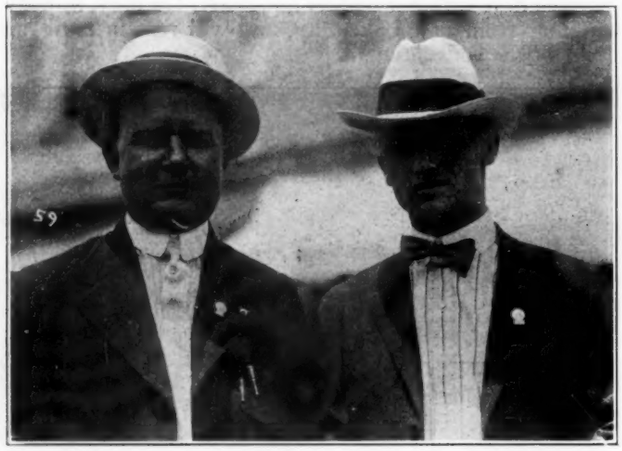
H. W. Ridgeway, Superintendent of Motive Power, Colorado & Southern, and Mrs. Ridgeway.

B. J. Coffman, acting mechanical engineer of the Richmond & Potomac, is attending his first convention. It is also his first visit to Atlantic City and he is enjoying every minute of it.

R. H. Dyer, Supervisor of Car Repairs, U. S. R. A.

This is the first convention George W. Wilden has attended as a railway supply man. He came to the last convention as superintendent of motive power of the New Haven. He is here this year as general manager of the Westinghouse Air Brake Company.

Mr. Michel, of A. Eugene Michel and Staff, advertising engineers, is here but is conspicuous by his absence from the pier, not that he hasn't the necessary headgear and overalls, but that he might the better serve his clients, he has been sticking pretty close to his temporary office in the Alamac Hotel.

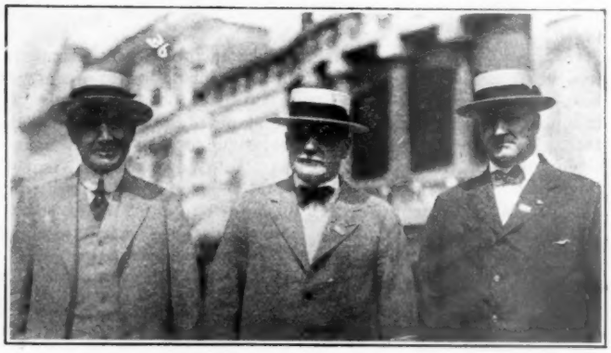


John Wintersteen, Cornwall Railroad, and Edward Clark, General Mechanical Foreman, Cornwall Railroad

It is probable that among the convention visitors could be found men and women with almost every form of accomplishment; and there are not a few men among them who have won fame in the game of golf. For instance, R. C. Vilas, president of the Pyle National Company, is now champion of the Exmoor Club, at Chicago. Robert Gwaltney, of the Symington Company, has been champion of New Jersey. Clayton Ingraham, president of the National Waste Company, is a fine player, and recently gave Max Marston a hard contest in a tournament, being beaten only one down by Marston. E. Hoover Bankard, of the Globe Seamless Tube Company, who is chairman of the Entertainment Committee this year, is a splendid player, and long has been chairman of the Green Committee of the Midlothian Country Club at Chicago. D. E. Sawyer, who recently went with the Pollak Steel Company, long has been

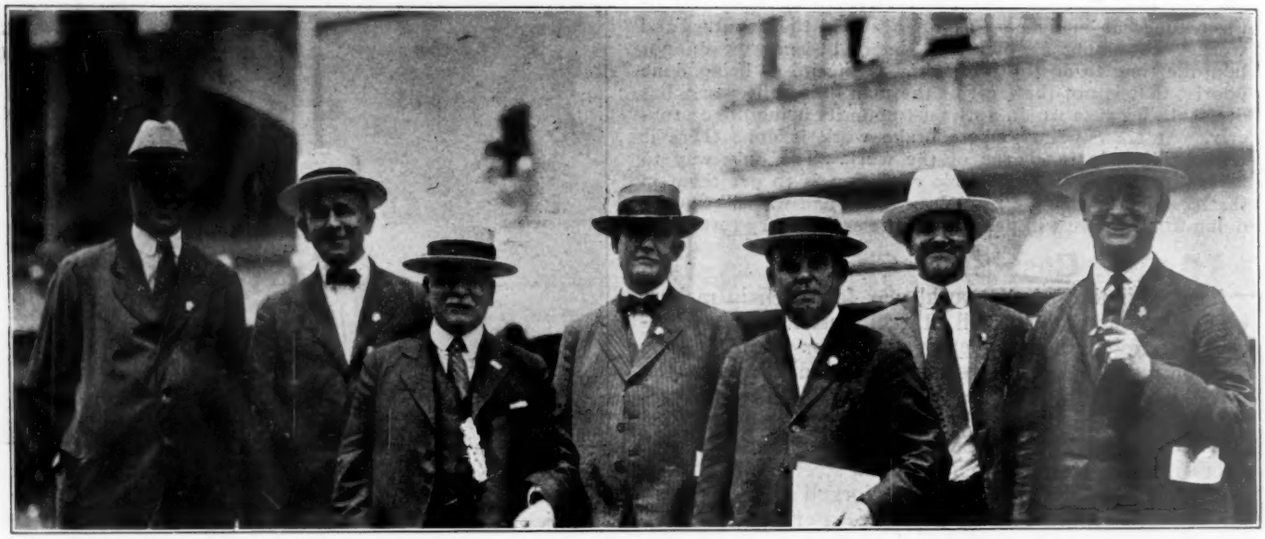
C. F. Giles, Superintendent of Motive Power, L. & N., and Mrs. Giles

known as one of the best golf players in the country. A team of a dozen players could be organized from



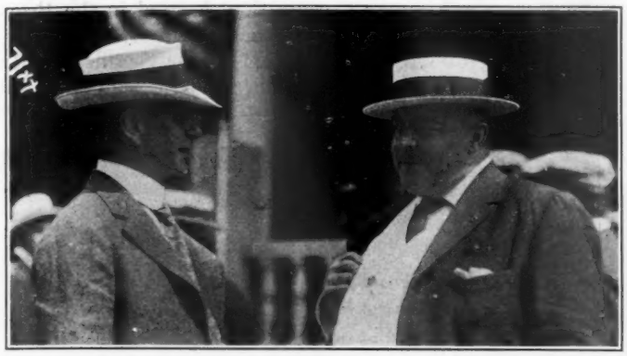
A. L. Humphrey. W. S. Bartholomew. and George W. Wildin; the Latter Attending His First Convention as a Railway Supply Man

among the attendants at the convention which would give any other team of amateurs in the country mighty hard competition.

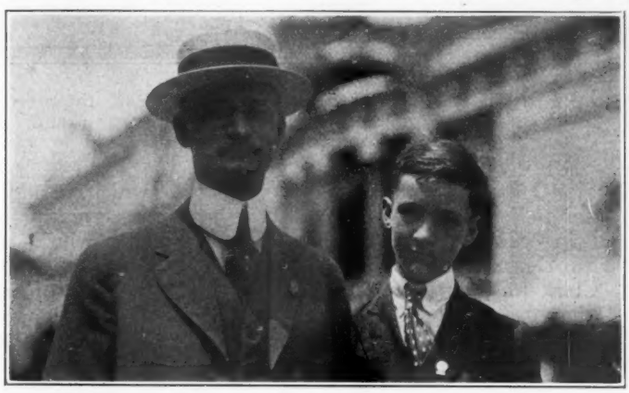


Left to Right. C. S. Patton, Supt. Motive Power, S. A. L.; J. W. Sasser, Supt. Motive Power, Norfolk Southern; Thomas Murcott, of Murcott & Campbell; C. H. Terrell, Assistant Supt. Motive Power, C. & O.; W. S. Butler, Master Mechanic, C. & O.; S. B. Andrews, Mechanical Engineer, S. A. L; E. A. Murray, Master Mechanic, C. & O.

To get a free ride in an aeroplane, and in addition receive a taxicab ride and $525 for taking it, would indicate that the man getting them was a business man as well as a sportsman. George Christianson, of the Johns-Manville Company, did it. Some of the other representatives of the same company offered to bet him $50 to $25 that he would not take an air trip This started the conversation. Mr. Christianson took the aeroplane ride yesterday, went in a taxicab to and from the place of ascension, all at the expense of his associates, and was $525 to the good at the expense of nine of them when he came down.

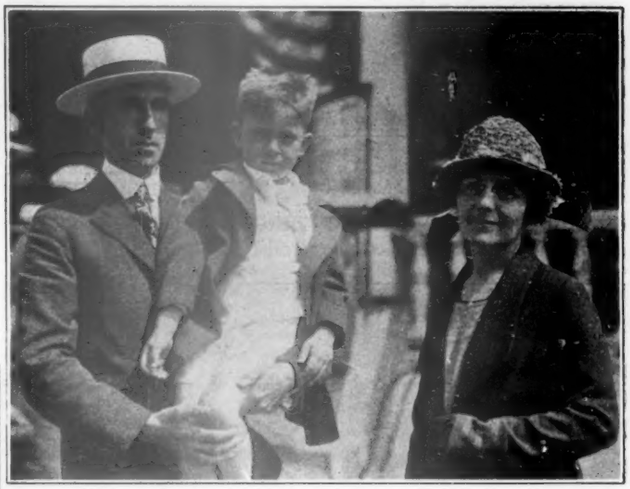


(Left) Willard Kells, General Superintendent of Motive Power, Atlantic Coast Line, and William Owens of the New York Air Brake Company

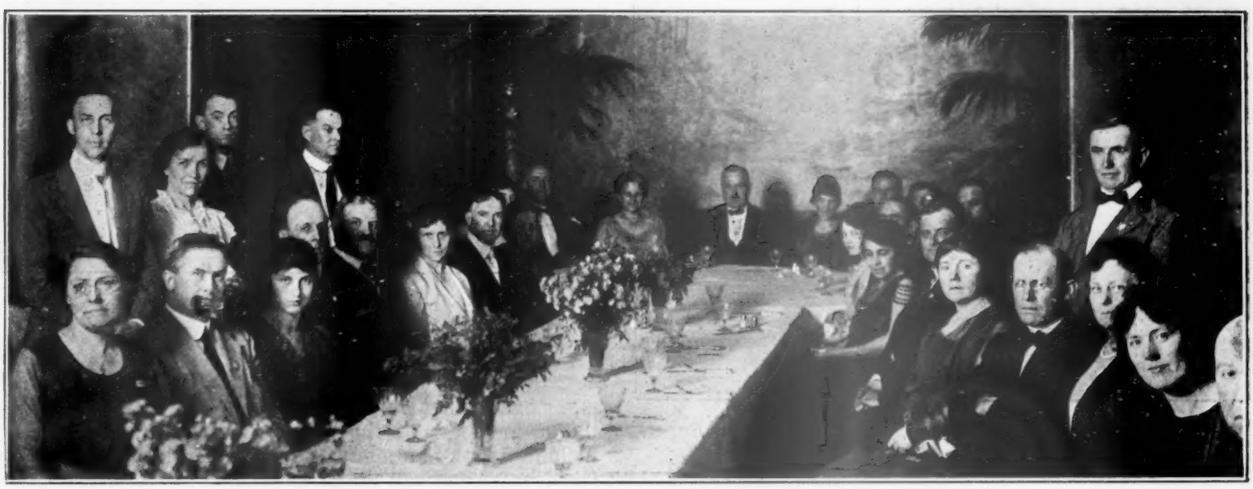


R. E. Mercur, Traffic Manager Westmoreland Coal Co., and his son, Henry.

How's this for Friday, the thirteenth and persistency? R. D. Stevenson, president of the Safety Nut and Bolt Company, Cleveland, Ohio, left for Atlantic City in his machine at 4.30 P. M., Friday the thirteenth of June. His entire exhibit was loaded in the rear of the tonneau. After proceeding a half dozen blocks he turned into a street which had recently been paved with asphalt and was oily and slippery. A horse and wagon appeared from an alley and a street car running alongside of them closed the gap, preventing further progress. In applying the brakes the car slid sideways and crushed the right side against the wagon; then the street car hit and crushed the left side of the car. After untangling the machine from the mix-up, he found the engine still running smoothly and the front axles in line—so he started again. When about 20 miles out of Cleveland the emergency brake, which had been set too tight in the beginning, burnt up and it was necessary to call in the assistance of a neighboring farm boy, who rushed a pail of water to the machine. After adjusting the brakes he proceeded, reaching Pittsburgh at 2.30 A. M. Saturday. Here ended his troubles as the balance of the trip to Atlantic City was without further troubles.



James Tierney, Master Mechanic, Louisiana & Arkansas, Mrs. Tierney and a future Master Mechanic, Stanley Tierney.

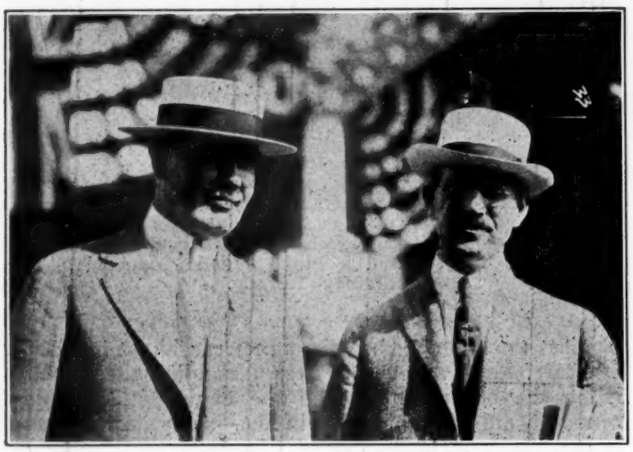


Guests at Dinner Given in Honor of Frank McManamy on Saturday Evening

P. C. Cady, well known in electric headlight circles, was seen in the Traymore dining room yesterday with

C. M. Dally, Machinist, C. R. R. of N. J.; H. L. Sandhas, General Inspector, C. R. R. of N. J.

five of the recently arrived Latin-American visitors. We don't know where Paul acquired his knowledge of Span-



George Thompson, M. C. B., New York Central, and George F. Laughlin, Superintendent Car Department, Armour Car Lines

ish, but he seemed to be following them closely. One of his guests admitted that on his first visit to the United

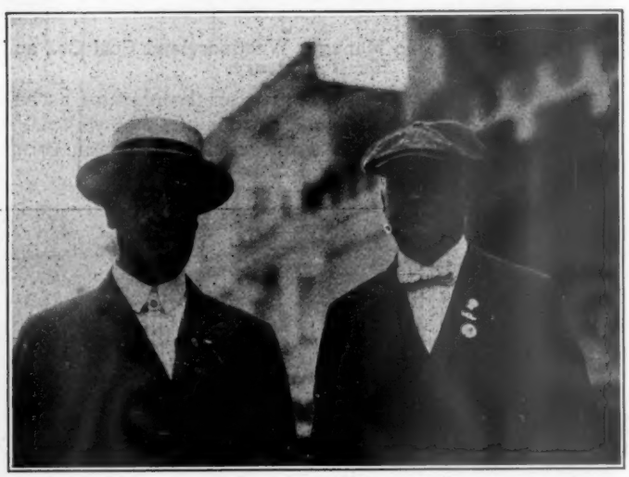
Franklin Hess, Son of George F. Hess, Mechanical Superintendent, Kansas City Southern, and Ellsworth L. Mills, American Reduction Sales Company

States some years ago he indicated his choice on the menu and was served with five different kinds of salads. He says that he didn't have the courage to send them back, so he ate them all and the waiter took him for a vegetarian.

Señor Juan M. Clark, formerly administrator of Central Perserverancia, one of the seventeen properties of the Cuba Cane Sugar Corporation, located in the Province of Santa Clara, Cuba, is the latest arrival of distinguished visitors from the "Pearl of the Antilles." Mr. Clark represents the corporation, which is said to be the largest producer of sugar in the world. It owns more

Left to Right: P. Vilaseca of J. Vileseca Bas, Importers; Ramon Morros of the Railway Construction and Materials Company, both of Barcelona

than 2,000 cars and over 100 locomotives, which, in addition to being equipped with electric headlights, are rapidly being converted into oil burners. Mr. Clark, who is at the Dennis, will return to Havana next Saturday. Mr. Clark was joined on Monday morning by several of his "amigos" from Cuba, consisting of Señor Alberto Gou, of Central Lequertio, in the Province of Santa Clara, also

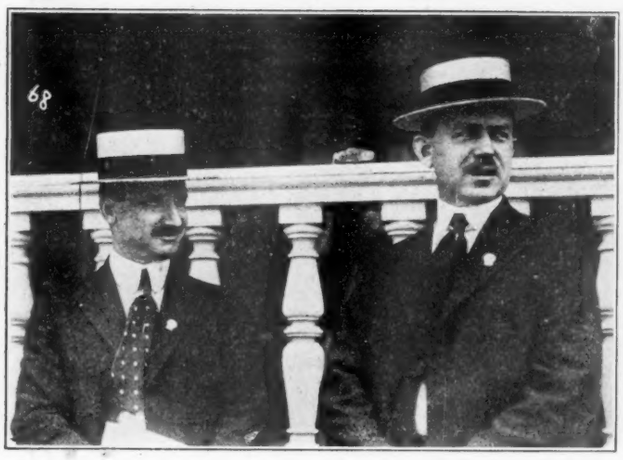


W. O. Thompson and F. W. Brazier, New York Central

a property of the Cuba Cane Sugar Corporation. Mr. Gou is accompanied by his son "Albertico," who will enter one of the engineering schools in the United States. Other members of this group of distinguished visitors include Señor Santiago Estevez, general manager of the Cardenas-American Sugar Company, of Cardenas, Cuba, who is with his son, Santiago, Jr., a student at the University of Pennsylvania.

Deniston Wood, Assistant Mechanical Engineer, Southern Pacific

Andre Rhue, Engineer, Schneider et Cie. Creusot Works, Paris, France.



(Left) C. B. Keiser, Superintendent Motive Power, P. R. R., and (Right) J. L. Cunningham, Superintendent Motive Power, P. R. R.

The New England Railroad Club at its annual meeting usually presents a program purposely intended to "mix up" the members and furnish entertainment. At the last meeting in March, two of our conventionites

Left to Right: E. F. Durham, General Car Inspector, M. K. & T. R. R.; R. L. Burch, General Car Foreman, Kansas City Suothern R. R.; S. W. Devinnt, Joint Inter-Change Car Inspector, U. S. R. A.

put on a sketch that broke all encore records and made a decided hit. N. A. Campbell, with the New York Air Brake Company for over twenty years, much better known as "Sandy" or "Scotty," is an artist at telling Scotch stories. His friends say that he never has had

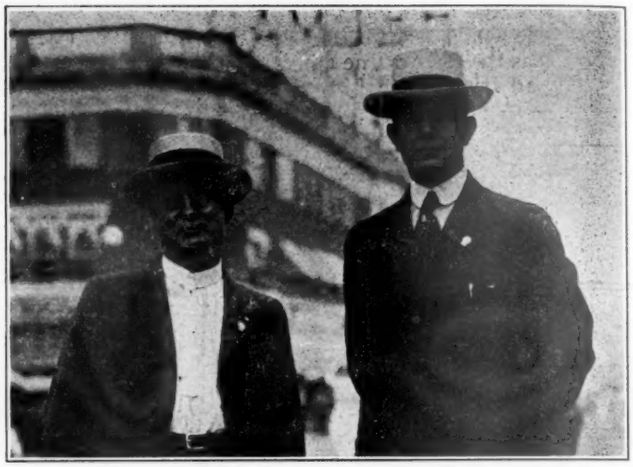
a "chestnut" in his "reservoir" and that he is in great demand as a story teller. George W. Denyven, of the Parkesburg Iron Company, Rome Iron Mills and the Pollak Steel Company, is also a dialect story teller and plays the bagpipe. He has been at all of the conventions for nine years and takes an active part in the

show, this year serving as a member of the Enrollment Committee. "Deny" says he can play grand opera on the bagpipe, but the best we have ever heard is "Cock of the North' 'and "How Dry I Am." As a result of the sketch put on at the N. E. R. R. Club, they were offered flattering terms to go on the stage, due to the fact that it is reported Harry Lauder is about to retire.

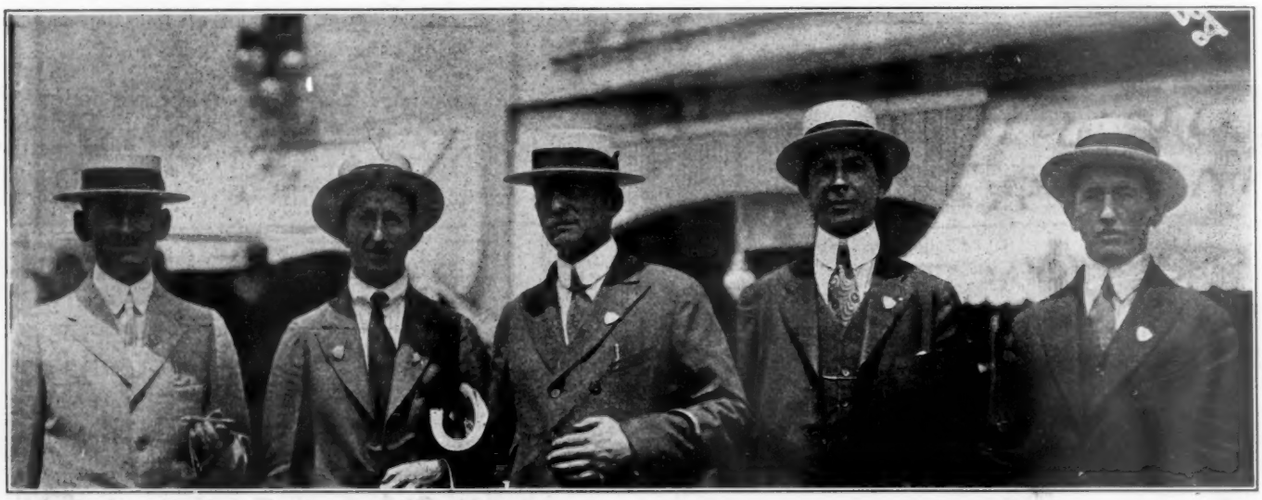
"Multum in Parvo"

"Lunch?"
"Bowl?"
"Well, good-bye."

Five words, and yet there is the whole story told about a friend of ours and yours—a prominent member of Section III, Mechanical, American Railroad Association; an ex-president of the M. C. B. or the M. M. Association, we will not say which. The gentleman is not given to the use of many words; he never was and never will be. And yet the sympathetic sign of approval or the rather stern sign of disapproval, always unmistakably noted in his eyes or in the nod of his head plainly indicate the trend of his thought to the listener.



Samuel Lynn, Master Car Builder, P. & L. E., and Karl Berg, Mechanical Engineer, P. & L. E.



The Visitors From Latin America

Left to Right: Ben Elliot, Master Car Builder, United Railways of Havara; Frank De Wolff, Locomotive Superintendent, Cuban Central Railway; O. R. Hale, Locomotive Superintendent, United Railways of Havana; Juan Henderson, General Inspector of Locomotives, United Railways of Havana, and Juan Romañach, Locomotive Superintendent of the Cuba Cane Sugar Corporation—all of Havana.

More Latin-American Visitors

Left to Right: "Albertico" Gou, Santiago Estevez, general manager, Cardenas American Sugar Co., Cardenas; Juan M. Clark, Cuba Cane Sugar Corporation, Havana; Alberto Gou, administrator Central Lequeitio; Lequeitio Santiago Estevez, Jr., of of the University of Pennsylvania

Well, one day a long-time friend from a distant city called. He was greeted with a hearty handshake and inasmuch as the hour of the day was about luncheon time our railroad friend looked into the eyes of the visitor in a kindly way and simply said:

Admiral C. W. Dyson, U. S. N., and Mrs. Dyson

"Lunch?"

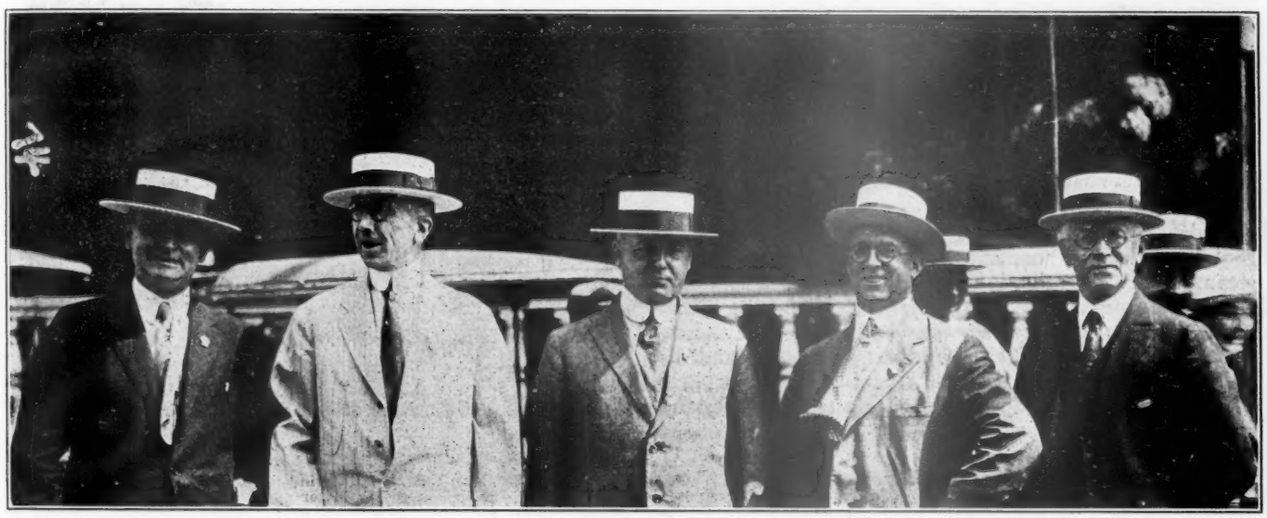
The man from out of town thanked the gentleman for the invitation and the two men proceeded to a club where an attractive luncheon was served. Of course, the guest chose for the meal the appetizing things he desired and the host simply smiled in an approving way to the waiter. So the order was duplicated. During the meal the guest did quite all of the talking we are informed, but he was at all times listened to in a friendly and interestedly manner. As they rose from the table the host said simply:

"Bowl?"

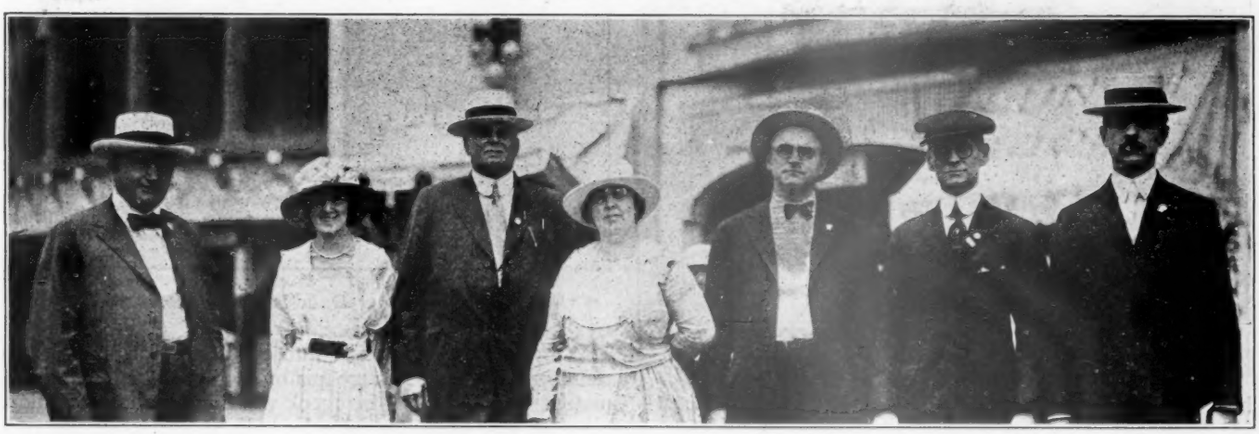
"Why, yes, I'd like to," said the guest. So they went to a nearby bowling alley and enoyed two frames of the game. As the two men left the place the guest thanked his host for a most pleasant luncheon and said he must be on his way. A hearty hand shake followed as our railroad friend said simply:

"Good-bye."

A temporary illness in New York prevented the early arrival at Atlantic City of George W. Lyndon, president of the Association of Manufacturers of Chilled Car Wheels. Mr. Lyndon, however, was on hand shortly after the opening exercises and will remain until the close.



Left to Right: F. S. Gallagher, Assistant Engineer of Rolling Stock, N. Y. C.; T. J. Burns, Supt. Rolling Stock, M. C.; W. H. Flynn, Supt. Motive Power, M. C.; G. E. Parks, Mechanical Engineer, M. C., and D. F. Jennings, of Guilford S. Wood Co.



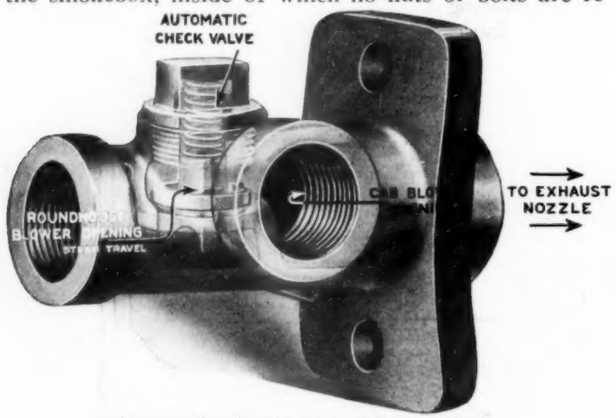
Left to Right: William Schlafge, General Mechanical Superintendent, Erie; Miss Carroll, sister of Mrs. Quinn; M. Quinn, General Foreman Car Repairs, Erie Lines, East; Mrs. Quinn; F. M. Graff, Superintendent Apprentices and Production, Erie; Stanley Bullard, Bullard Machine Tool Co.; A. G. Trumbull, Assistant General Mechanical Superintendent, Erie

New Devices Among the Exhibits

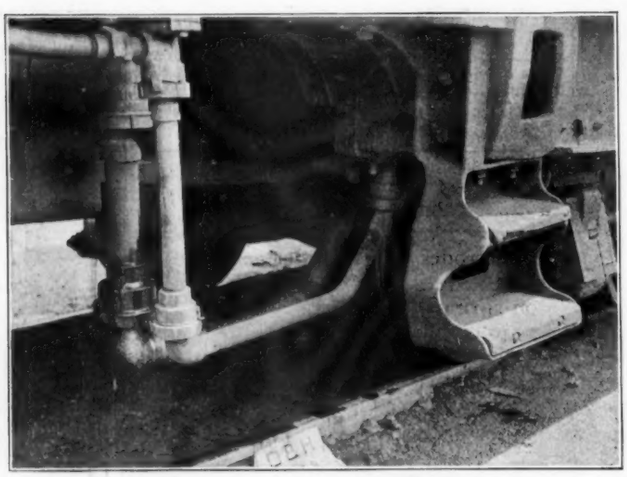
Automatic Smokebox Blower Fitting

LEAKLESS, PLUGLESS, THREADLESS, automatic in action, and always ready, are some of the claims made for the automatic smokebox blower fitting, which is so plainly illustrated in the photograph that it requires but slight description.

Cap screws secure the flange or body of the fitting to the smokebox, inside of which no nuts or bolts are required. All that is required in the attaching of the roundhouse steam hose is to screw it on and turn on the steam; the check valve is raised by the steam in its passage to the smokebox. When steam is up and the roundhouse pipe is disconnected, the blower valve in the cab furnishes the balance of the draft necessary and the check valve prevents leakage of steam to the atmosphere. This device, which is applied to all United States Standard locomotives is known as the Barco automatic smokebox blower fitting and is made by the Barco Manufacturing Company, Chicago.



Automatic Smoke Box Blower Fitting



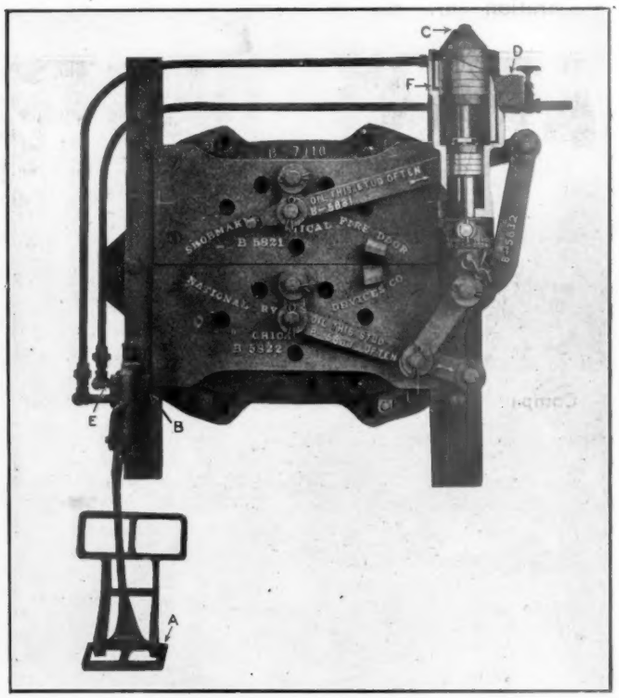
Barco 3-V Feed Water Connection

The Barco 3-V type engine tender connection which has been used for some time for air and steam lines, is now being used for water connections as well. The illustration below shows a typical application. For this purpose 2½-in. joints and 2½-in. extra heavy pipe are used. One of the important advantages of the arrangement is its reliability. There is no possibility of a loose lining obstructing the flow of water, the connection cannot collapse, and if "blowing back" is necessary there is no danger that it will burst or be blown off. In addition to the increase reliability it is claimed that a reduction in the cost of maintenance is secured by the use of the Barco water connection.

A Vertical Automatic Fire Door

THE NATIONAL RAILWAY DEVICES COMPANY, Chicago, is exhibiting the Shoemaker vertical automatic fire door as applied to the United States Railroad Administration locomotives. This door is of the balanced type and is pneumatically operated, both in the opening and closing movement.

The short leverage required to move the doors and the short piston travel necessary to operate the levers are distinctive features. In the opening operation of this door the pedal *A* is pressed downward, thus lifting a foot valve which closes the exhaust port *B*, admitting air through the foot valve and the admission valve *C* to the top side of the large piston, which forces both the pistons downward. The check valve *D* admits a constant air reservoir pressure into the cylinder between the two pistons, and at the same time as the downward movement reduces the volume between them, a proportionately greater pressure is built up, which near the completion



The Shoemaker Door In Closed Position

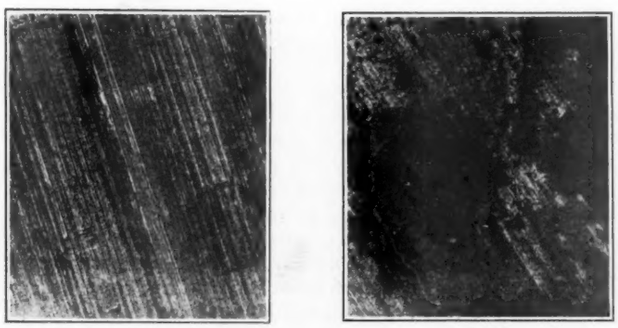
of the stroke balances with the reservoir pressure and brings the door to the open position without shock.

To close the door the pedal *A* is released, thus setting the foot valve which blocks the air at *E*. Port *B* opens, permitting the free escape of air through port *F*, forcing the pistons upward because of the greater pressure underneath. When port *F* is closed by the large piston an air cushion is formed in the top of the cylinder, and as this is relieved through a small hole in the plunger of the admission valve, the door closes without slamming. The doors can be cracked by means of the pawl at the lower end of the air cylinder.

This company is also showing a Shoemaker fire door of the vertical automatic twin type, designed for application to locomotives having wide fire door openings, such as those used in the anthracite regions. The design of this door permits the exposing of one-half of the door opening, while the other half remains closed, thus admitting less air into the firebox and at the same time providing ample opening for convenient firing.

Chemical Specialties for Railroad Use

WITHIN THE PAST YEAR the Dearborn Chemical Company, Chicago, has brought out a compound for rust prevention known as No-Ox-Id. This product is said to keep metal surfaces in perfect condition when exposed to the elements for months. It is used extensively by the War Department to protect guns, machinery, airplanes and munitions from rust. The illustration shows the condition of two pieces of metal,



Comparative Corrosion of Metal Protected by No-Ox-Id and by Oil

one coated with No-Ox-Id and the other covered with oil, after exposure to the weather. The part covered with No-Ox-Id was not rusted, while the other piece was badly corroded in spite of the coating of oil. No-Ox-Id has been adopted by manufacturers of steel products of every kind and, in view of the great need for a thoroughly efficient rust preventive, in railroad work, it is anticipated that it will find a wide field of application.

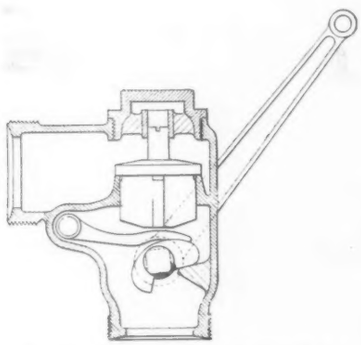
Dearboline is another article of interest to railway men and is intended for use in cleaning metals. It is adapted for washing steel cars and for general metal washing purposes and is economical and effective for cleaning locomotives and car trucks of accumulated dirt.

Dearboline is free from acid or other corrosive substances, and does not harm painted or varnished surfaces. It is extensively used to remove grease, cutting compounds, oils, iron filings, and other foreign substances, from iron or steel articles during the manufacturing process. Other new products of the Dearborn Chemical Company are cutting, quenching and drawing oils, and Kleen-Kleen, a cleansing preparation which has many uses.

Drifting Valve

A SAFE, QUICK-OPENING DRIFTING VALVE, easily operated by hand or by an extension rod, even under the highest boiler pressure, is being exhibited by William Sellers & Co., Inc., Philadelphia, Pa.

It is intended to be used in open or closed positions only. The special feature is the cam cast solid with the stem operating a latch, and which by compound leverage raises a loosely fitting winged check. It is a type of



Sectional View of Drifting Valve

valve which remains tight in service, is easily accessible and can be reground or the valve replaced without removing from the pipes.

The older form of quick-opening drifting valve consisted of a pilot and main valve placed on a horizontal step; this form was always difficult to keep steam tight; the present form by its simplicity and the special design of steam check, eliminates all the objections to the quick-opening hand operating drifting valve.

Electric Rivet Heater

THE BERWICK ELECTRIC RIVET HEATER is an inductive type of furnace. It consists of a primary coil to suit characteristics of the alternating current supply and a very heavy secondary coil of only one turn; this secondary is divided at one end into four electrodes.

The electrodes of the heater are opened and closed by foot pedals, and pedal connections are used with compression springs. The primary coil is so constructed that a free air circulation keeps the windings cool.

Rivet heating is done by inserting the cold rivet lengthwise between the electrodes and then closing the line switch, which is very conveniently located at the left side of the heater where the operator has control of the heating at all times, thereby saving unnecessary fuel loss and burned rivets.

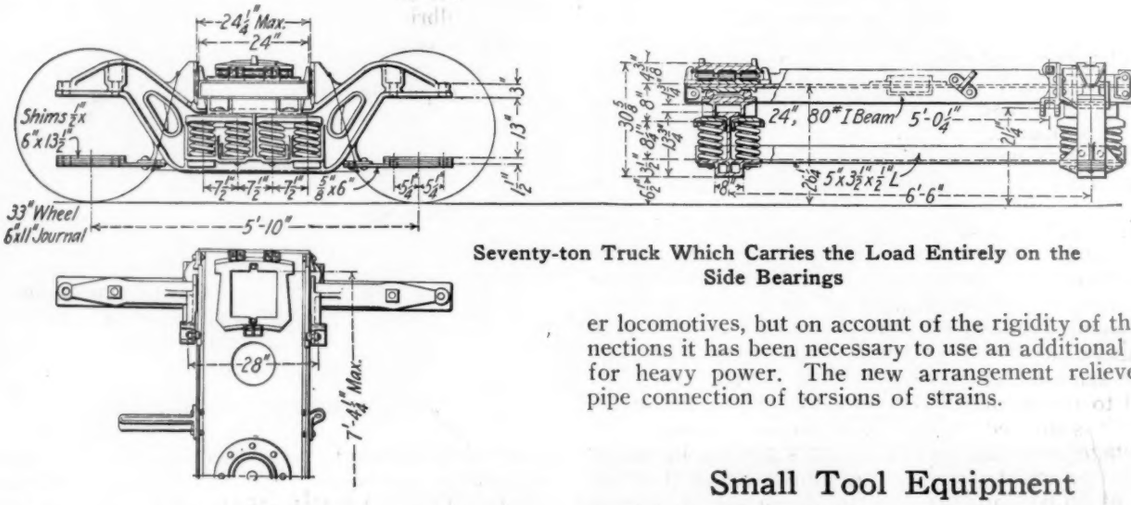
This heater is built in four sizes to heat rivets, ¼ in. by 2 in. up to 1⅜ in. by 10 in. It is claimed that the current consumption is 20 kilowatt hours per 100 lb. of rivets.

It embodies the feature of being portable, simple to operate, makes no smoke or fumes, and is economical.

The heater is made by the American Car and Foundry Company.

Barber 70-Ton Truck

A TRUCK OF 70 TONS CAPACITY in which the load is carentirely on the side bearings has been developed by the Standard Car Truck Company, Chicago, and is being exhibited on the pier. This type of construction delivers the load from the body bolster directly over the center of each side frame and materially reduces stresses in the truck bolster. In the design which is being exhibited the side bearings are spaced 6 ft. 6 in. from center to center. Each side bearing has twelve rollers 2 in. in diameter and 3¼ in. long, located radially about the center pin. The base of the roller casing is bolted to the truck bolster. The center section, when assembled, locks the rollers in place and the top of the casing is curved to allow the bearing to adjust itself to the irregularities of the track. The center pin extends through the bolster but no load is carried at this point, the pin serving only to pivot the truck and to move it.



Seventy-ton Truck Which Carries the Load Entirely on the Side Bearings

Each end of the bolster rests on lateral rollers which seat in a casting fitting into the spring caps and bridging the compression member of the truck side frame. Eight M. C. B. Class B springs are used arranged in two nests of four each. If desired, six springs of greater capacity can also be used. The spring plank consists of two 5 in. by 3½ in. by ½ in. angles. The side frames are of cast steel, the compression member being lowered to pass under the bolster. This truck has been in service for some time and a car equipped with it is being exhibited at Mississippi Avenue.

Pneumatically Operated Cable Hoist

AMONG THE DEVICES EXHIBITED by the Independent Pneumatic Tool Company, Chicago, is a one-ton pneumatic hoist which is equipped with a motor similar to that used in corner drills. The main features of the hoist are the worm drive and automatic stop arangement, which prevents jamming of the cables at any point. The worm drive is designed to suspend the load indefinitely. The reversing mechanism has a cam attached to a parallel shaft, which engages a geared tooth rack, shifting the position of the eccentric, and thereby giving the operator absolute control of the load at all times. It is equipped with roller bearings throughout, which, in addition to the oil splash design, reduces friction to a minimum. When in operation it is impossible for the cable to work out of the grooves and cross or jam, thus eliminating a trouble usually found in all pneumatic hoists. Hoists of this type are being manufactured in capacities ranging from one-half to three tons.

Increased Flexibility in Engine and Tender Pipe Connections

THE FRANKLIN RAILWAY SUPPLY COMPANY, New York, is exhibiting an application of the McLaughlin joints for engine and tender pipe connections which is made up of three double joints instead of the usual arrangement of two double and one single joint. The latter arrangement has proved satisfactory on smaller locomotives, but on account of the rigidity of the connections it has been necessary to use an additional sleeve for heavy power. The new arrangement relieves the pipe connection of torsions of strains.

Small Tool Equipment

THE WILLIAM BREWSTER COMPANY, 30 Church Street, New York, is exhibiting what is known as Bell-Mouth sockets and sleeves for drills. These tools are standard sockets and sleeves with a bell mouth or annular recess at the open end. This recess protects the taper tool seat no matter how badly the outside edge of the sleeve or socket is battered. This device overcomes the troubles so frequently encountered with a drill or reamer which is used in a socket that has been so battered that the tool seat is irregular and causes the tool to wabble. With the use of the Bell Mouth socket this cannot occur as the taper seat is protected by the bell mouth, and the life of both the socket and the tool itself is greatly prolonged.

De-Magnetizer

The Bulldog De-Magnetizer is a device designed for the purpose of de-magnetizing such tools as milling cutters, files, micrometers, etc., which, due to magnetism, collect small particles of metal which adhere to the cutting edges and lower the efficiency of the tool. The device consists of a de-magnetizer in a rectangular container with a flexible connection that may be readily attached to any lighting fixture.

The machine is ready to connect to 110 volts or 220 volts, 60-cycle ,single phase, alternating current circurt, or may be furnished to connect to other requencies and voltages. If direct current only is available, a D-C to A-C rotary converter can be used. There are no moving parts—therefore, no repairs. This device absolutely eliminates all magnetism instantly and the power consumed is approximately the same as used in burning an ordinary light bulb.

This company is also showing the Etchograph, which is an electric marking apparatus for use in marking tools,

micrometers, gages, etc., and is valuable because of its flexibility and the ease and speed with which it may be used. The only wearing part is the point of the pencil which may be replaced with ordinary copper wire. This device may be connected to a lighting fixture, and it uses power only when it is etching.

The Brewster Company also show the vertical drilling and counter sinking devices manufactured by the Liberty Tool Company, of Baltimore, Md., which were described in the daily *Railway Age* on June 20.

Oil Handling Apparatus

IN CONNECTION with the discussion as to the advisability of eliminating the bottom outlet valve from tank cars it is interesting to note that there is being exhibited at the convention, equipment developed as the result of a careful survey and analysis of the conditions covered in the paper by A. W. Gibbs and the discussion on that subject. S. F. Bowser & Co., Fort Wayne, Ind., have developed equipment for unloading and measuring the contents of tank cars without opening the bottom outlet valve. To accomplish this a special suction connection of the rigid or non-rigid type is inserted in the manhole of the tank car to be emptied. This pipe is carried to a direct connected, motor driven pump, of a type adapted to the liquid or liquids to be handled. An automatic self-measuring and self-regulating control gives a record of the contents removed accurate to one-half of one per cent and also controls the operation of the pump.

The same equipment can be used for the distribution of oil to the point where it is used or to containers in which it is shipped, in any predetermined quantity. The advantages over the present methods secured by the use of this equipment consist in the elimination of the possibility of spillage and leakage and the saving of time and labor. It insures the safe and rapid transfer of the entire contents of the tank car to the permanent storage without the necessity for constant attendance, and is so designed as to be practically foolproof in its operation.

Murphy Solidsteel Plate Roof

IN AN ENDEAVOR to provide a design adapted to present conditions, the Standard Railway Equipment Company, Chicago, has developed a new type of roof known as the Murphy Solidsteel roof. This roof makes the steel superstructure a solid unit and not only protects the lading, but also serves as a cover plate for the superstructure. Weaving on a riveted joint very soon loosens rivets or crystalizes and breaks the metal, so that in steel car construction in order to obtain the best efficiency it is necessary to eliminate weaving. In this class of equipment the solid steel rigid roof ties the top securely and makes the entire body of the car act in unison to prevent weaving and a consequent enlargement of bolt holes and distortion of the wooden lining.

The Murphy Solidsteel roof has outside carlines formed by upstanding flanges on the roof sheets in combination with a seam cap secured together with horizontal rivets, both heads of which are outside the car, so that a loose or bad rivet cannot cause a leak. The outside edge of the roof is riveted to the side plate in such a manner that both heads are outside of the car, and no leaks can be caused by loose rivets. The outside carlines give the maximum inside clearance for lading. On double sheathed cars with wooden sides and ends it is impossible to prevent a certain amount of weaving due to the shrinkage of the lumber; therefore a flexible roof was necessary on that type of equipment. But on the modern steel underframe, steel frame box car, with underframe, ends and sides securely riveted together, a roof which will add to the strength of the entire structure is felt to be necessary.

A High Heat Resisting Brick

A SPECIALLY PREPARED cellular insulating refractory brick for furnaces and other structures which is made in standard firebrick sizes and other special shapes, and whose weight is said to be about one-half of the ordinary firebrick, is the latest product of the Quigley Furnace Specialties Company, New York. This material, called Insulbrix, is shown in its booth. It is stated that insulbrix has a low thermo conductivity, one inch of insulbrix being equal to six to ten times the same thickness of fire or red brick. It is also said to have high heat resisting qualities, the fusing point being 2,900 deg. F. without showing shrinkage at as high a temperature as 1,800 deg. F. This material, it is said, will withstand a crushing strength of over 425 lbs. to the square inch.

The Quigley Company is also exhibiting a new and specially designed controller for the close regulation of fuel feed from furnace bins to individual burners in furnaces. By turning a handwheel the fuel feed may be adjusted for any range of control between minimum and maximum capacity. The feed screw is driven at constant speed, but the adjustment of the feed to the burner is accomplished by means of a diaphragm or pair of shutters closing around the screw, giving an adjustable opening leading to the discharge head.

Tuco North Pole Sanitary Drinking Fountain

THE TUCO PRODUCTS CORPORATION, NEW YORK, is exhibiting a sanitary drinking fountain, the construction and operation of which involves a number of interesting features. The fountain proper consists of three parts, a filter, a storage tank for filtered water and an ice compartment, in the bottom of which is placed a shallow, enclosed cooling pan, through which the water flows from the storage tank to the faucet. The water supply is drawn from the air pressure water system, first passing through a filter stone into the storage tank. The water is drawn from the faucet directly from the cooling tank, which holds about three cups. The ice compartment which is located below the storage tank, where it is readily accessible, is insulated to prevent undue thawing of the ice.

Provision is made for convenient and thorough cleaning of all parts of the cooler. By the removal of five clamps the filter casing may be removed and the stone taken out by unscrewing the pipe connection, with which it is attached to the fixed end of the filter case. It is then easily and thoroughly cleaned by steam or submersion in hot water. An opening is provided on the front of the storage tank near the bottom, which is closed by a plug. Removal of this plug permits the interior of the tank to be cleaned by the insertion of a steam nozzle. To drain the system a cock is opened in the bottom of the cooling tank, which permits the water in the storage tank to flow directly into the ice chamber and thence out through the drain. The drain from the ice chamber is closed by a tubular plug, the opening into which is located several inches above the bottom of the chamber. The removal of this plug allows the ice chamber to be drained.

These filters have been in service for several years in a large number of coaches on several railway systems The service has demonstrated that the cooler is sanitary. The ice and drinking water are not in contact, and the filter removes all sediment which may pass to it from the compressed air storage system. The insulated ice tank has effected a saving of 50 to 60 per cent as compared with the ordinary type of water cooler. This saving was demonstrated in tests in comparison with both sleeping cars and ordinary day coaches, and it reduces the amount of labor required to keep the filter in operation because icing is less frequent. It also prevents the waste of water as the rate of flow is such that only one glass of water will flow freely at one time. It is also safer to keep in operation than the ordinary water coolers because filling does not require the use of ladders and buckets or hose, on top of the car.

The cooler equipment, complete, is enclosed in a compartment which opens on the inside of the car with the ice tank located at a convenient height for filling.

National Car Door

ONE OF THE DEVICES exhibited on the pier which has been developed since the last convention is the National car door. This door is supported directly on the underframe on rollers of large diameter, mounted in brackets which do away with the track. This method of support was adopted to place the weight of the door at the point where the distortion of the frame would be a minimum. The rollers themselves are designed to prevent freezing up with snow or ice and can be loosened by a slight jar in case they clog. The bottom of the bracket is opened, permitting any foreign matter to fall through. The door being supported at the bottom brings the handle close to the line of support and prevents binding or cocking.

The top interlocking feature is so arranged that snow and ice cannot accumulate and prevent free movement of the door; with the front and back interlocking connection to the door post it forms a weather and spark-proof construction. By the use of beveled rollers in the brackets the door when shut is kept tight against the car. Flat rollers and a lug on the brackets keep the door away from the car when open, preventing binding and injury to the sheathing and insuring easy operation. This door is built by the Union Metal Products Company, Chicago, and has been specified for application to the entire 25,000 double sheathed box cars ordered by the United States Railroad Administration.

Moncrieff's Reflex Gage Glass

PRIOR TO THE WAR a large number of reflex water gage glasses were imported from Germany and this glass was considered the most satisfactory for the purpose. Since the supply of German glass has been cut off many inferior glasses have been thrown upon the market which have indirectly injured the reputation of the Klinger type gage. During the war a process was developed by John Moncrieff, Ltd., Perth, Scotland, manufacturers of tubular gage glasses, for the manufacture of a specially toughened reflex gage glass. The glasses are not moulded, but are cut from a special quality of plate glass and toughened. They are said to withstand a steam pressure of 350 lb. or more, and have withstood the severest acceptance tests. The British Admiralty tests glasses of this kind by dropping a six-ounce ball from a height of seven feet on the glass, which is supported at the ends. It has been tested in the same manner with an eight-ounce hard wood ball, without injuring or fracturing the glass. The Moncrieff reflex gage glasses are distributed in the United States by H. A. Rogers Company, New York.

Single Hoist Grab Bucket

THE DESCRIPTION of the automatic single hoist grab bucket, exhibited by Edgar E. Brosius, Pittsburgh, Pa., which appeared on page 1694 of the June 23d issue of the *Daily Railway Age*, was accompanied by an illustration showing a single hook grab bucket instead of an automatic single hoist grab bucket. The single hook bucket operates on a one-drum crane and can be taken off in the same manner as a sling chain. The automatic single hoist grab bucket differs from the one which was illustrated in that it is on the machine permanently, with the sheave block attached to the hinge frame and the rope extending up directly to the hoist drum. This type of bucket dumps automatically from a predetermined height.

Pulverized Coal Locomotive on Mississippi Avenue

ON THE MISSISSIPPI AVENUE TRACK, near Pacific Avenue, is a Lehigh Valley 10-wheel locomotive, which has just been equipped for burning pulverized coal, by the Fuller Engineering Company, Allentown, Pa. This locomotive arrived at Atlantic City too late to be exhibited during the first week of the convention, but is now ready for inspection.

The locomotive has a Wootten type boiler, and the equipment is designed to handle either all anthracite or all bituminous coal, or a 50 per cent mixture of both. The engine is being kept under steam in order to demonstrate the equipment in actual operation.

A New Departure in Sheet Metal Cutting

A MACHINE WHICH ALLOWS the cutting of a sheet of metal into practically any desired shape, leaving every portion of the material in its former flat condition, is being exhibited by the Swind Machinery Company, of Philadelphia, Pa. It is known as Gray's sheet metal cutter and is manufactured by the W. J. Savage Company, Inc., Knoxville, Tenn.

The process of cutting takes out a clean kerf much the same as a jig saw does in wood, the stock being guided in any direction at the will of the operator. The metal is automatically advanced to the cutter in a manner which resembles the feeding of the cloth to the needle of a sewing machine. The use of this machine is said to eliminate the necessity of straightening out material, which after being cut with the usual methods invariably tends to curl or buckle.

This machine at present is being made in four sizes and will cut metal up to and including 5/8 in. in thickness; it is specially useful in cutting out lagging plates, liners and templates.